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Firearms Stolen during Household Burglaries and Other Property Crimes, 2005–2010

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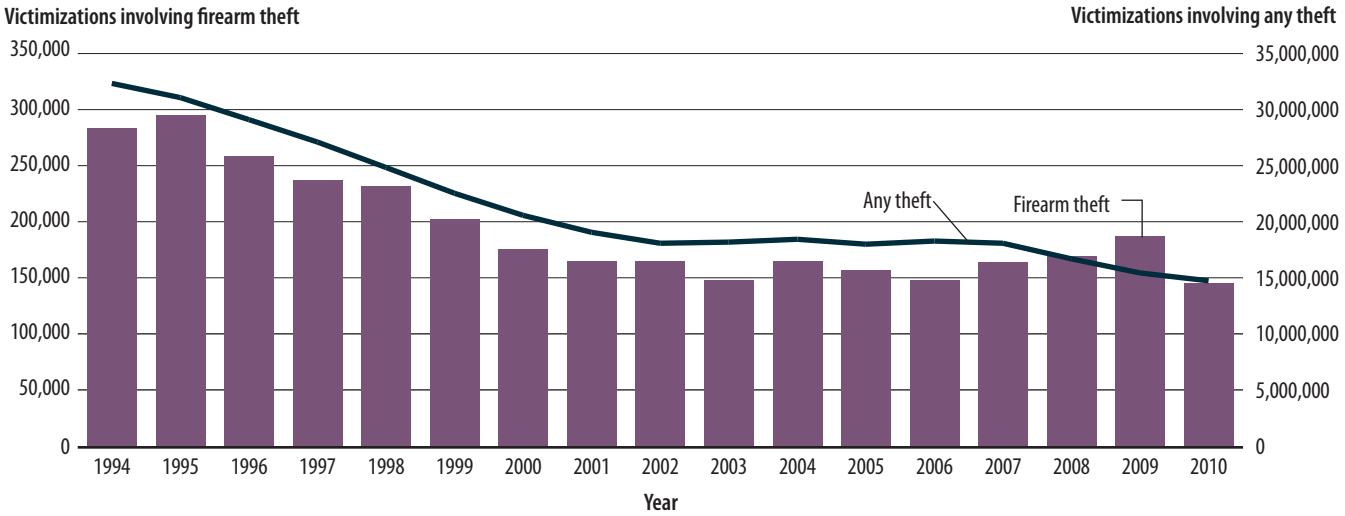
Victimizations involving the theft of firearms declined from 283,600 in 1994 to 145,300 in 2010 (figure 1). Overall, about 1.4 million guns, or an annual average of 232,400, were stolen during burglaries and other property crimes in the six-year period from 2005 through 2010. Of these stolen firearms, at least 80% (186,800) had not been recovered at the time of the National Crime Victimization Survey (NCVS) interview.

The data in this report were drawn from the Bureau of Justice Statistics' (BJS) NCVS, which annually collects information on nonfatal victimizations reported and not reported to the police against persons age 12 or older from a nationally representative sample of U.S. households. The NCVS collects data on criminal incidents for which theft or attempted theft is either a component of the victimization (i.e., robbery, personal larceny, burglary, motor vehicle theft, and other property theft) or could occur in connection with the victimization (i.e., rape or sexual assault). This report examines the theft of firearms in criminal victimizations, focusing on the rate, number, amount of loss, and recovery of guns taken during burglaries and other property crimes, which include motor vehicle theft and other theft. It presents information on how firearms may end up in the hands of persons to whom they do not belong.

Trend estimates are based on two-year rolling averages centered on the most recent year (figure 1). For example, estimates reported for 2010 represent the average estimates for 2009 and 2010. This method improves the reliability and stability of estimate comparisons over time. For all tables in this report, aggregate data for the time from 2005 through 2010 are the focus.

FIGURE 1
Victimizations involving any theft and firearm theft, 1994–2010



Note: Data based on two-year rolling averages. See appendix table 1 for standard errors.
Source: Bureau of Justice Statistics, National Crime Victimization Survey, 1993–2010.

Firearms were stolen in 2% of violent and 1% of property crimes involving theft from 2005 through 2010

On average, firearms were stolen in an annual average of about 4% of the 2.4 million burglaries occurring each year, in 2% of the 529,200 robberies, and in less than 1% of the 13.6 million other crimes involving theft from 2005 through 2010 (table 1). Burglaries accounted for 58% of the 153,900 victimizations each year in which a gun was stolen, and robberies accounted for about 7% of the victimizations involving a gun theft. About 0.4% of thefts involved the theft of a gun, yet thefts accounted for about a third (33%) of the victimizations in which a gun was stolen. Overall, about 93% of gun thefts occurred during property crimes. Therefore, the remainder of this report focuses on property crime.

Between 1994 and 2010, no statistically significant change was observed in the percentage of completed burglaries or other property crimes that involved the theft of at least one firearm (figure 2). This may suggest that the overall decline in the number of victimizations involving gun theft was not due to a decline in the number of privately owned guns that could be stolen.

TABLE 1
Average annual victimizations involving the theft of at least one firearm, by type of crime, 2005–2010

	Any theft[a]	Firearm theft	
Type of crime	Number	Number	Percent of any theft
Violent	537,090	10,440 !	1.9% !
Rape or sexual assault	7,940 !	--	--
Robbery[b]	529,150	10,440 !	2.0 !
Personal larceny	171,910	--	--%
Property	15,828,190	143,480	0.9%
Burglary	2,394,250	89,400	3.7
Motor vehicle theft	670,700	3,060 !	0.5 !
Other theft	12,763,250	51,020	0.4

Note: Numbers rounded to the nearest 10. See appendix table 2 for standard errors.

--Less than 0.5 or 0.05%.

[a]Includes victimizations in which at least one item was stolen. Excludes attempted burglaries and other attempted property crimes.

[b]Assaults involving theft are classified as robberies.

! Interpret with caution; estimate is based on 10 or fewer sample cases, or coefficient of variation is greater than 50%.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2005–2010.

FIGURE 2
Completed burglaries and other property crimes involving the theft of at least one firearm, 1994–2010

Note: Data based on two-year rolling averages. See appendix table 3 for standard errors.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 1993–2010.

Handguns were the most common type of firearm stolen

At least one handgun was stolen in 63% of burglaries involving gun theft (table 2). In 19% of burglaries, a handgun was stolen along with another type of firearm. About 39% of burglaries involving gun theft resulted in the theft of multiple guns, compared to about 15% of other property crimes involving gun theft. An average of about three guns were stolen during burglaries involving the theft of multiple guns, and about two guns were stolen during other property crimes involving multiple gun thefts. Due to the greater percentage of victimizations involving more than one gun, as well as the greater number of victimizations involving stolen firearms each year, burglaries accounted for nearly three times as many stolen guns than did other property crimes. In the six-year period from 2005 through 2010, an average of about 172,000 guns were stolen during burglaries and 60,300 guns were stolen during other property crimes each year. A total of 1.4 million guns were stolen during the six-year period.

Property crimes involving only stolen firearms resulted in an average annual loss of $27 million

Each year from 2005 through 2010, households that experienced gun theft from burglaries or other property crimes lost a total of about $600 million on average from these crimes. The majority of the loss was from other items stolen along with firearms. Households that experienced the theft of a firearm and other items had a mean loss of $7,600 in burglaries and $4,700 in other property crimes (table 3). The mean loss when only one gun and nothing else was stolen was between $400 and $500 per incident. Among households that experienced burglaries and other property crimes in which a gun was the only type of item stolen, the total loss was about $27 million per year.

TABLE 2

Average annual burglaries or other household property crimes involving the theft of at least one firearm, by theft characteristic, 2005–2010

	Burglary		Other property crimes	
Theft characteristic	Number	Percent	Number	Percent
Number of stolen firearms*	172,040	~	60,320	~
Victimizations by stolen item	89,400	100%	54,080	100%
Firearm only	22,620	25	24,720	46
Firearm and at least one other item	66,790	75	29,360	54
Victimizations by type of stolen firearm	89,400	100%	54,080	100%
Handgun	39,210	44	35,890	66
Other firearm	33,260	37	17,340	32
Both	16,940	19	850 !	2 !
Victimizations by number of stolen firearms	89,400	100%	54,080	100%
One	48,470	54	41,490	77
More than one	35,000	39	8,060	15
Unknown	5,940	7	4,520 !	8 !

Note: Numbers rounded to the nearest 10. See appendix table 4 for standard errors.

*Excludes the annual average 5,940 burglaries for which the number of firearms stolen was unknown.

~Not applicable.

! Interpret with caution; estimate is based on 10 or fewer sample cases, or coefficient of variation is greater than 50%.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2005–2010.

TABLE 3

Loss attributed to burglaries or other property crimes involving the theft of at least one firearm, 2005–2010

Stolen item	Burglary	Other property crimes
One firearm only and no other items[a]		
Mean	$500	$400
Median	$400	$300
Average annual total	$7,220,200	$6,759,600
More than one firearm and no other items[b]		
Mean	$2,900 !	$900 !
Median	$800 !	$600 !
Average annual total	$10,136,300 !	$2,430,200 !
One or more firearms and other items[c]		
Mean	$7,600	$4,700
Median	$3,000	$2,000
Average annual total	$465,952,200	$131,977,500

Note: Numbers rounded to the nearest 100. See appendix table 5 for standard errors.

[a]Excludes 7% of households experiencing gun theft in which number of firearms stolen was unknown, 4% of households experiencing gun theft during burglary and 10% of households experiencing gun theft during other property crimes that did not report the value.

[b]Excludes 11% of households experiencing gun theft that did not report the value.

[c]Excludes 8% of households experiencing gun theft during burglary and 5% of households experiencing gun theft during other property crimes that did not report the value.

! Interpret with caution; estimate is based on 10 or fewer sample cases, or coefficient of variation is greater than 50%.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2005–2010.

Nearly 90% of burglaries involving stolen firearms were reported to the police

From 2005 through 2010, 86% of burglaries and 75% of other property crimes involving a stolen firearm were reported to police (table 4). Households were more likely to report to the police burglaries or other property crimes involving a stolen gun than property crimes in which other items with comparable value were stolen (approximately $500 on average).

Among burglary victimizations, a greater percentage of households reported the incident to the police when a handgun (91%), another type of firearm (76%), or both (94%) were stolen than when other items valued from $500 to $999 were stolen (62%). A slightly greater percentage of households reported the theft of one firearm and no other items stolen to the police (77%) (not shown in table) than other stolen items valued from $500 to $999 (62%).

About 4 of 5 firearms stolen during household property crimes were not recovered

In 83% of burglaries and 85% of other property crimes that involved a stolen firearm, none of the stolen guns had been recovered at the time of the NCVS interview (table 5). Assuming these guns were not recovered later, this amounts to an annual average of at least 135,000 unrecovered guns from burglaries and 51,800 unrecovered guns from other property crimes.

Although the victimizations involving stolen firearms could have occurred from one day to up to six months before the NCVS interview, the amount of time that had elapsed made no significant difference in the percentage of households for which guns had not been recovered at the time of the interview (not shown in table).

TABLE 4

Percent of burglaries or other property crimes involving theft reported to police, by theft characteristic, 2005–2010

	Burglary		Other property crimes	
Theft characteristic	Number	Percent reported to police	Number	Percent reported to police
Victimizations by stolen item	89,400	86%	54,080	75%
Firearm only	22,620	79%	24,720	65%
Firearm and at least one other item	66,790	88	29,360	84
Victimizations by type of stolen firearm				
Handgun	39,210	91%	35,890	82%
Other firearm	33,260	76	17,340	64
Both	16,940	94	850	41 !
Victimizations by number of stolen firearms				
One	48,470	83%	41,490	74%
More than one	35,000	90	8,060	82
Unknown	5,940	86	4,520	77 !
Victimizations involving other stolen items by loss*	1,911,770	56%	10,858,920	35%
$0–$99	330,800	26	4,322,500	19
$100–$499	604,600	43	4,194,600	34
$500–$999	297,140	62	898,850	52
$1,000 or more	679,226	82	1,443,000	80

Note: Numbers rounded to the nearest 10. See appendix table 6 for standard errors.

*Includes victimizations in which at least one item was stolen, excluding firearms. Excludes attempted burglaries and other attempted property crimes.

! Interpret with caution; estimate is based on 10 or fewer sample cases, or coefficient of variation is greater than 50%.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2005–2010.

TABLE 5

Average annual recovery of items stolen during burglaries or other property crimes, 2005–2010

	Burglary		Other property crimes	
	Number	Percent	Number	Percent
Number of stolen firearms[a]	172,040	100%	60,320	100%
Recovered	9,080 !	5 !	3,310 !	5 !
Not recovered	135,010	78	51,820	86
Unknown[b]	27,950	16	5,180 !	9 !
Victimizations involving a stolen firearm	89,400	100%	54,080	100%
All items recovered	3,910 !	4 !	3,060 !	6 !
Some items recovered	9,080	10	4,720 !	9 !
No items recovered	74,030	83	45,760	85
Unknown	2,390 !	3 !	540 !	1 !
Victimizations involving other stolen items[c]	2,304,800	100%	13,379,870	100%
All items recovered	94,470	4	953,580	7
Some items recovered	88,060	4	529,270	4
No items recovered	2,051,030	89	11,172,270	84
Unknown	71,300	3	724,750	5

Note: Numbers rounded to the nearest 10. Across households interviewed within the first six months after gun theft victimization, no differences were detected in the percentage of households that reported no firearms recovered. See appendix table 7 for standard errors.

! Interpret with caution; estimate is based on 10 or fewer sample cases, or coefficient of variation is greater than 50%.

[a]Excludes gun thefts in which the number of stolen firearms was unknown.

[b]Includes burglaries and other property crimes in which at least one firearm and at least one other item were stolen and some items were recovered because it was unknown whether the some items recovered included a firearm.

[c]Includes victimizations in which at least one item other than a firearm was stolen. Excludes attempted burglaries and attempted other thefts.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2005–2010.

No items had been recovered at the time of the NCVS interview in a lower percentage of burglaries involving the theft of a firearm (83%) than in burglaries involving the theft of items other than guns (89%). Among other property crimes, there was no difference in the percentage of incidents from which no items were recovered regardless of whether the victimization involved theft of a gun or other items. In about 85% of other property crime victimizations, no items were recovered.

The majority of property crimes involving stolen firearms occurred in the South

An estimated 22% of burglaries involving a stolen firearm occurred in households comprised of one male adult with no children. In contrast, these households accounted for 13% of all households (table 6). Households comprised of one female adult with no children experienced 8% of the burglary victimizations in which a gun was stolen, while accounting for 16% of households nationwide.

A greater percentage of households with two or more adult residents with children experienced gun theft during burglaries or other property crime victimizations than households with one male or female adult resident with children. Households with a white non-Hispanic head of household accounted for the majority of burglaries and other property crimes in which a gun was stolen. White non-Hispanics also accounted for the majority of U.S. households (71%).

Households in the South were more likely than households in other regions to have experienced gun theft during burglaries or other property crimes. Households in the South accounted for 37% of all households in the U.S., but 56% of all burglaries and 59% of other property crimes involving the theft of a firearm. Similarly, a disproportionate percentage of households in rural areas experienced burglaries involving the theft of a gun (34%), compared to the overall percentage of households in rural areas (17%).

TABLE 6
Characteristics of households that experienced burglary or other property crimes involving the theft of at least one firearm, 2005–2010

		Burglary		Other property crimes	
Household characteristic	All households	Firearm theft	Other theft	Firearm theft	Other theft
Household structure	100%	100%	100%	100%	100%
Two or more adults					
Without children	52	45	46	54	53
With children	14	16	13	13	19
One male adult					
Without children	13	22	14	19	10
With children	1	5 !	2	3 !	1
One female adult					
Without children	16	8	14	7 !	8
With children	5	4 !	11	4 !	7
Race and Hispanic origin	100%	100%	100%	100%	100%
White*	71	75	64	78	68
Black/African American*	12	14	18	13	13
Hispanic/Latino	11	7	13	6 !	14
American Indian/Alaska Native*	1	2 !	1	1 !	1
Asian/Native Hawaiian/ other Pacific Islander*	4	1 !	2	-- !	3
Two or more races*	1	1 !	2	2 !	2
Household income	100%	100%	100%	100%	100%
Less than $25,000	18	20	29	22	22
$25,000–$49,999	20	21	21	26	22
$50,000 or more	32	30	24	31	33
Not reported	30	29	26	21	23
Location of residence	100%	100%	100%	100%	100%
Urban	33	23	39	28	40
Suburban	50	43	41	51	46
Rural	17	34	20	21	15
Region	100%	100%	100%	100%	100%
Northeast	18	4 !	12	6 !	13
Midwest	23	19	25	16	23
South	37	56	41	59	36
West	22	21	22	19	28

Note: See appendix table 8 for standard errors.

*Excludes persons of Hispanic or Latino origin.

--Less than 0.5%.

! Interpret with caution; estimate is based on 10 or fewer sample cases, or coefficient of variation is greater than 50%.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2005–2010.

Methodology

Survey coverage

The National Crime Victimization Survey (NCVS) is an annual data collection conducted by the U.S. Census Bureau for the Bureau of Justice Statistics (BJS). The NCVS is a self-report survey in which interviewed persons are asked about the number and characteristics of victimizations experienced during the prior six months. The NCVS collects information on nonfatal personal crimes (rape or sexual assault, robbery, aggravated and simple assault, and personal larceny) and property crimes (burglary, motor vehicle theft, and other theft) both reported and not reported to police.

The NCVS is administered to persons age 12 or older from a nationally representative sample of households in the United States. The NCVS defines a household as a group of members who all reside at a sampled address. Persons are considered household members when the sampled address is their usual place of residence at the time of the interview and when they have no usual place of residence elsewhere. Once selected, households remain in the sample for three years, and eligible persons in these households are interviewed every six months for a total of seven interviews. New households rotate into the sample on an ongoing basis to replace outgoing households that have been in the sample for the three-year period. The sample includes persons living in group quarters, such as dormitories, rooming houses, and religious group dwellings, and excludes persons living in military barracks and institutional settings, such as correctional or hospital facilities, and the homeless. (For more detail, see the *Survey Methodology* in *Criminal Victimization in the United States, 2008,* NCJ 231173, BJS website, May 2011.)

In 2010, about 41,000 households and 73,300 individuals age 12 or older were interviewed for the NCVS. Each household was interviewed twice during the year. The response rate was 92.3% of households and 87.5% of eligible individuals.

From 2005 through 2010, the primary reference period for this data brief, a total of 835,000 persons from about 472,000 households were interviewed. This equates to an annual average of 139,000 persons age 12 or older in 79,000 households interviewed each year from 2005 through 2010.

Victimizations that occurred outside of the U.S. were excluded from this report. From 2005 through 2010, about 1% of the total unweighted victimizations involving theft of a firearm occurred outside the U.S. and were excluded from the analyses. Also excluded were the smaller number of attempted burglaries and other thefts in which the perpetrator tried to steal a firearm. The NCVS is unable to measure whether safes, locks, alarms, or other target hardening devices were in place in the home. The use of anti-theft measures may vary by population demographics.

Weighting adjustments for estimating household victimization

Estimates in this report use data from the 1993 to 2010 NCVS data files. These files are weighted to produce annual estimates of victimization for persons age 12 or older living in U.S. households. Because the NCVS relies on a sample rather than a census of the entire U.S. population, weights are designed to inflate sample point estimates to known population totals and to compensate for survey nonresponse and other aspects of the sample design.

The NCVS data files include both person and household weights. Person weights provide an estimate of the population represented by each person in the sample. Household weights provide an estimate of the total U.S. household population. Both household and person weights, after proper adjustment, are also used to form the denominator in calculations of crime rates.

Victimization weights used in this analysis account for the number of persons present during an incident and for repeat victims of series incidents. The weight counts series incidents as the actual number of incidents reported by the victim, up to a maximum of 10 incidents. Series victimizations are similar in type but occur with such frequency that a victim is unable to recall the details of each individual event. Survey procedures allow NCVS interviewers to identify and classify these similar victimizations as series victimizations and to collect detailed information on only the most recent incident in the series.

In 2010, about 3% of all victimizations were series incidents. Weighting series incidents as the number of incidents up to a maximum of 10 incidents produces more reliable estimates of crime levels, while the cap at 10 minimizes the effect of extreme outliers on the rates. Additional information on the series enumeration is detailed in the report *Methods for Counting High Frequency Repeat Victimizations in the National Crime Victimization Survey,* NCJ 237308, BJS website, April 2012.

Trend estimates provided are based on two-year rolling averages centered on the most recent year. For example, estimates reported for 2010 represent the average estimate from 2009 through 2010. This method is used to smooth trend lines and improve the reliability of estimates by increasing the sample sizes for each annual average estimate.

Standard error computations

When national estimates are derived from a sample, as is the case with the NCVS, caution must be taken when comparing one estimate to another estimate or when comparing estimates over time. Although one estimate may be larger than another, estimates based on a sample have some degree of sampling error. The sampling error of an estimate depends on several factors, including the amount of variation in the responses, the size of the sample, and the size of the subgroup for which the estimate is computed. When the sampling error around the estimates is taken into consideration, the estimates that appear different may, in fact, not be statistically different.

One measure of the sampling error associated with an estimate is the standard error. The standard error can vary from one estimate to the next. In general, for a given metric, an estimate with a smaller standard error provides a more reliable approximation of the true value than an estimate with a larger standard error. Estimates with relatively large standard errors are associated with less precision and reliability and should be interpreted with caution.

In order to generate standard errors around estimates from the NCVS, the Census Bureau produces generalized variance function (GVF) parameters for BJS. The GVFs take into account aspects of the NCVS complex sample design and represent the curve fitted to a selection of individual standard errors based on the Jackknife Repeated Replication technique. The GVF parameters were used to generate standard errors for each point estimate (such as counts, percentages, and rates) in the report.

In this report, BJS conducted tests to determine whether differences in estimated numbers and percentages were statistically significant once sampling error was taken into account. Using statistical programs developed specifically for the NCVS, all comparisons in the text were tested for significance. The primary test procedure used was Student's *t*-statistic, which tests the difference between two sample estimates. To ensure that the observed differences between estimates were larger than might be expected due to sampling variation, the significance level was set at the 95% confidence level.

Data users can use the estimates and the standard errors of the estimates provided in this report to generate a confidence interval around the estimate as a measure of the margin of error. The following example illustrates how standard errors can be used to generate confidence intervals:

> According to the NCVS, from 2005 through 2010, 86% of burglaries involving the theft of a firearm were reported to police (see table 4). Using the GVFs, BJS determined that the estimate has a standard error of 2.6% (see appendix table 5). A confidence interval around the estimate was generated by multiplying the standard errors by ±1.96 (the *t*-score of a normal, two-tailed distribution that excludes 2.5% at either end of the distribution). Thus, the confidence interval around the 86% estimate is equal to 86% ± 2.6% X 1.96 (or 80.9% to 91.1%). In other words, if different samples using the same procedures were taken from the U.S. population during the period from 2005 through 2010, 95% of the time the percentage of burglaries involving gun theft that were reported to police would fall between 80.9% and 91.1%.

In this report, BJS also calculated a coefficient of variation (CV) for all estimates, representing the ratio of the standard error to the estimate. CVs provide a measure of reliability and a means to compare the precision of estimates across measures with differing levels or metrics. In cases where the CV was greater than 50%, or the unweighted sample had 10 or fewer cases, the estimate was noted with a "!" symbol (interpret data with caution; estimate is based on 10 or fewer sample cases, or the coefficient of variation exceeds 50%).

Many of the variables examined in this report may be related to one another and to other variables not included in the analyses. Complex relationships among variables were not fully explored in this report and warrant more extensive analysis. Readers are cautioned not to draw causal inferences based on the results presented.

Appendix: External measures of gun ownership, gun stock, and gun theft

Gun theft in this report varies by demographic group. This variation is driven, in part, by the prevalence of gun ownership; however, the NCVS does not collect information on gun ownership. This appendix describes external measures of gun ownership, stock, and theft. One of the limitations of this report is that NCVS data are not aligned with these external measures to the extent that rates of firearm theft can be easily or reliably computed from a denominator of households with guns or the total number of guns in the United States. For example, although the NCVS shows a decline in the percentage of households experiencing firearm theft from 1994 to 2010, and the General Social Survey and Gallup poll both show declines in the percentage of households owning firearms during the same period, when these data were combined to generate trends in the rate of firearm theft among gun-owning households, no differences were detected in the rate in 1994 compared to 2010 (figure 3). This may be indicative of stability in the rate of gun theft among gun-owning households over time or it may be a function of the lack of precision due to the large standard errors associated with generating estimates from surveys with different sampling methodologies. Similarly, while the UCR theft measure provides context for these findings, due to methodological differences in the collection of data on firearm theft, direct comparison between NCVS and UCR measures of gun theft are not feasible.

Household gun ownership

Although a number of surveys have collected data on household gun ownership at the state level or at particular points in time,[1] there are two main sources of national data on long-term trends in household gun ownership: the General Social Survey (GSS) and the Gallup poll.

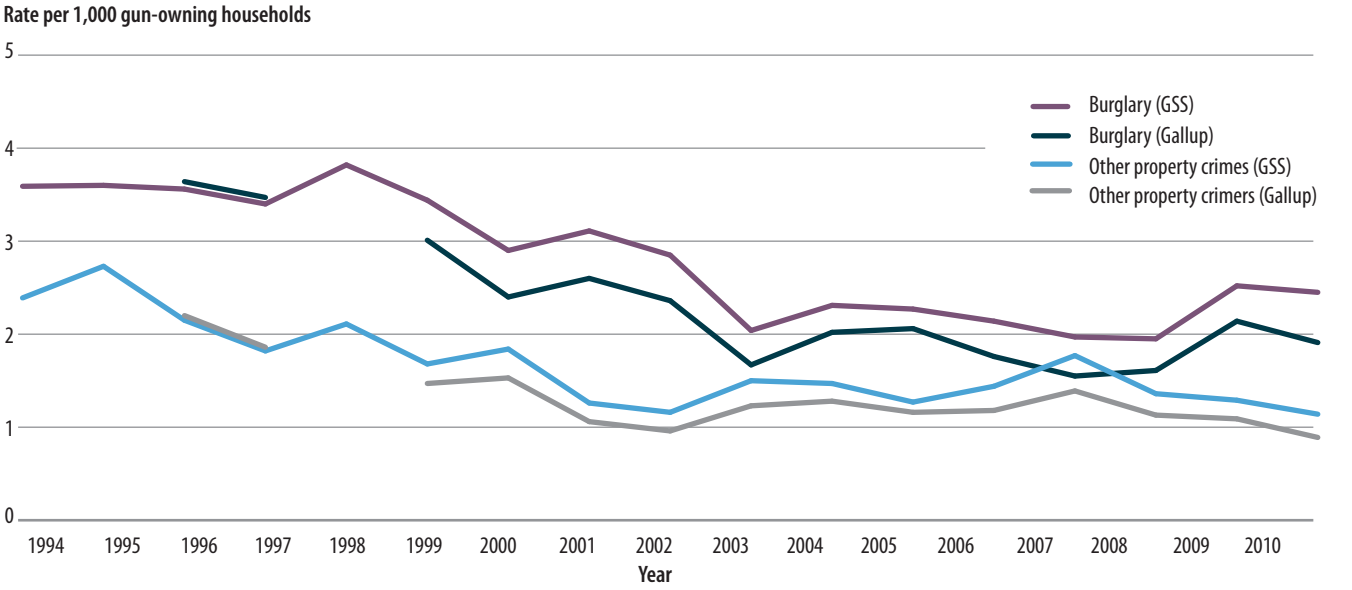
General Social Survey

The National Opinion Research Center (NORC) has administered the GSS since 1972 to collect data on the demographics, behaviors, and attitudes

[1]See Cook, P.J., & Ludwig, J. (1997). *Guns in America: Results of a Comprehensive National Survey on Firearms Ownership and Use.* Washington, DC: Police Foundation; Centers for Disease Control and Prevention (2001–04). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, GA: Centers for Disease Control and Prevention.

FIGURE 3

Rate of burglaries or other property crimes involving firearm theft, by General Social Survey (GSS) and Gallup poll estimates of household gun ownership, 1994–2010



Note: Data based on two-year rolling averages. Number of gun-owning households computed by applying the percentage of households with guns according to General Social Survey (GSS) and Gallup Organization to total number of households in NCVS. GSS collected data on household gun ownership in 1993 and 1994, and then every other year beginning with 1996. Gallup Organization produced estimates of households with a gun in the home or on the property in 1993, 1996, 1999, 2003–05, and 2007–10. In 1996, Gallup Organization produced percentage estimates of households with guns on the property multiple times during the year. For 1996, the average of the two estimates was used. For years in which the GSS or Gallup polls were not conducted, rate was based on the single year of data on household gun ownership. See appendix table 9 for standard errors.

Source: Bureau of Justice Statistics, National Crime Victimization Survey, 1993–2010; Gallup Organization, Guns, 1993–2010. Available at www.gallup.com/poll/1645/Guns.aspx; National Opinion Research Center, General Social Survey, 1993–2010.

of the U.S. population. In 1993 and every other year from 1994 through 2010, the GSS included the question, "Do you happen to have in your home (IF HOUSE: or garage) any guns or revolvers?" According to the GSS, the percentage of households that reported having a gun in the home declined from 46% in 1993 to 32% in 2010.[2]

Figure 3 uses GSS data to present trends in the rate of burglaries and other property crimes involving firearm theft per 1,000 gun-owning households. To compute the denominator for the rate, the percentage of GSS households that owned guns was applied to the total number of NCVS households for the year. The rate was then computed using two-year rolling averages.

The GSS and NCVS standard errors were pooled to compute a standard error around the rate. Although the GSS shows a significant decline in the percentage of households that owned guns from 1994 through 2010, the differences in the rate of burglaries and other property crimes involving firearm theft per 1,000 households across the period did not test at the $p<.1$ level using the pooled standard errors.

The GSS data were based on a full probability sample of persons age 18 or older living in noninstitutionalized arrangements in the U.S. Until 2004, the survey was administered to English-speaking persons only. Beginning in 2006, Spanish-speaking respondents were eligible. From 1993 to 2010, data on household gun ownership were collected from an average of about 1,500 respondents. For more information on the sampling and weighting of GSS data, see the GSS Codebook at http://publicdata.norc.org/GSS/DOCUMENTS/BOOK/GSS_Codebook.pdf.

[2]Smith, T.W., Marsden, P., Hout, M., & Kim, J. (2011). *General Social Surveys, 1972–2010* [machine-readable data file]. Chicago, IL: National Opinion Research Center.

Gallup poll

Gallup produces a national public opinion poll that dates back to 1935. Gallup frequently conducts polls of persons in U.S. households to measure opinions on gun possession rights and gun laws as well as household gun ownership. From 1993 to 2010, Gallup conducted 13 polls in which respondents were asked, "Do you have a gun in your home? Do you have a gun anywhere else on your property such as in your garage, barn, shed, or in your car or truck?" From December 1993 to October 2010, Gallup polls showed a decline in the percentage of households with guns on the property, from 54% to 41%.[3]

Figure 3 also uses Gallup data to show trends in the rate of burglaries and other property crimes involving firearm theft per 1,000 gun-owning households. The process of computing the denominator for the rate was the same as used with the GSS; the percentage of Gallup households that owned guns was applied to the total number of NCVS households for the year. The rate was then computed using two-year rolling averages.

Gallup reports that survey results are accurate within a margin of error of ±4%, so a conservative standard error of 2.04 was applied to all estimates. The Gallup and NCVS standard errors were pooled to compute a standard error around the rate. As with the rate computed using the GSS percentages from 1994 through 2010, the differences in the rate of burglaries and other property crimes involving firearm theft per 1,000 Gallup households that owned guns did not test at the $p<.1$ level using the pooled standard errors.

The Gallup data were based on adults age 18 or older with a landline or cellular telephone who were selected for the poll through a process of random-digit dialing. When a sampled household was contacted on a landline phone, Gallup pollsters requested an interview with the person age 18 or older who had the most recent birthday. Any person reached on a cellular phone was interviewed directly. For a standard survey, Gallup used a sample of between 1,000 and 1,500 persons. For more information on the Gallup polling methodology, see "How are polls conducted?" at http://www.gallup.com/poll/101872/How-does-Gallup-polling-work.aspx.

[3]Gallup poll, *Do you have a gun in your home? Do you have a gun anywhere else on your property such as in your garage, barn, shed or in your car or truck? [COMBINED RESPONSES] 1991–2011*. More information is available at www.gallup.com/poll/1645/Guns.aspx.

Gun stock

Bureau of Alcohol, Tobacco, Firearms and Explosives

The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) collects data on the number of firearms that are manufactured in, imported to, and exported from the United States each year. Measures of U.S. gun stock are sometimes computed by adding the number of manufactured guns to the number of imported guns and subtracting exported firearms to get a total for each year, and then summing across years to get a count of the total number of guns in circulation. In 2010, about 5.5 million guns were manufactured, about 2.8 million were imported, and about 240,000 were exported, giving a total of about 8.1 million new guns added to the existing gun stock in 2010.[4] Guns that were destroyed or otherwise removed from circulation were not taken into consideration in this count. Moreover, although the ATF counts exclude firearms manufactured for the U.S. military, they include firearms purchased by law enforcement agencies. Because of these limitations in using the ATF data to estimate the number of privately owned guns, the report does not include a rate of the number of stolen guns per 1,000 guns owned.

[4]United States Department of Justice, Bureau of Alcohol, Tobacco, Firearms, and Explosives. (2012). *Firearms Commerce in the United States: Annual Statistical Update*. Available at http://www.atf.gov/publications/firearms/050412-firearms-commerce-in-the-us-annual-statistical-update-2012.pdf.

Gun theft

Federal Bureau of Investigation

Through the Uniform Crime Reporting (UCR) Program, the Federal Bureau of Investigation (FBI) collects limited data on firearm theft and recovery. A supplemental UCR reporting form, which is optional for UCR participating agencies, collected monthly data from state and local law enforcement agencies on the aggregate dollar value of items stolen, by type of stolen item. The supplemental form also collected aggregate data on the value of items recovered by police. In addition to collecting information on items stolen and recovered from household burglaries and other property crimes, the supplemental form collected information on burglaries and other property crimes involving commercial establishments. From 2005 through 2010, out of the approximate 17,800 agencies that submitted UCR data annually, about 13,000 agencies submitted supplemental data that were eligible for inclusion in *Crime in the United States*.[5]

From 2005 through 2010, the FBI agencies that submitted supplemental data reported that an average of $122 million worth of firearms was stolen each year. During the same period, an average of $11 million worth of stolen firearms (or about 8.7% of the value of total stolen firearms) was recovered each year.[6] Because the NCVS estimates of monetary loss include the monetary value of any other items stolen along with firearms, the UCR and NCVS estimates of the monetary value of stolen firearms cannot be directly compared. The UCR data cannot be used to generate an estimate of the number of incidents that involved a gun theft because the value of different types of firearms varies and agencies only submit aggregate data on the total value of all firearms stolen during the reporting period.

[5]For more information on the FBI's Uniform Crime Reporting Program, see http://www.fbi.gov/about-us/cjis/ucr. UCR supplemental data on the value of firearms stolen and recovered for each year are found in Table 24, Property Stolen and Recovered.

[6]FBI, Uniform Crime Reporting Program, *Crime in the United States*, 2005–2010.

APPENDIX TABLE 1
Standard errors for figure 1: Victimizations involving any theft and firearm theft, 1994–2010

Year	Any theft	Firearm theft
1994	590,249	36,591
1995	502,990	32,649
1996	468,347	29,489
1997	577,414	30,217
1998	592,407	30,383
1999	548,249	29,676
2000	521,475	26,295
2001	540,625	25,611
2002	254,400	24,793
2003	233,933	24,591
2004	236,801	27,290
2005	234,726	26,305
2006	199,490	23,654
2007	186,702	27,850
2008	180,638	28,112
2009	289,119	29,713
2010	331,249	25,503

APPENDIX TABLE 2
Standard errors for table 1: Average annual victimizations involving the theft of at least one firearm, by type of crime, 2005–2010

	Any theft	Firearm theft	
Type of crime	Number	Number	Percent of any theft
Violent	67,818	8,603	1.6%
Rape or sexual assault	6,011	~	~
Robbery*	52,405	6,703	1.3
Personal larceny	25,421	~	~%
Property	319,335	25,897	0.2%
Burglary	94,077	16,318	0.7
Motor vehicle theft	46,548	2,889	0.4
Theft	286,858	15,167	0.1

*Assaults involving theft are classified as robberies.
~Not applicable.

APPENDIX TABLE 3

Standard errors for figure 2: Completed burglaries and other property crimes involving the theft of at least one firearm, 1994–2010

Year	Burglary	Other property crimes
1994	0.6	0.1
1995	0.6	0.1
1996	0.6	0.1
1997	0.6	0.1
1998	0.7	0.1
1999	0.8	0.1
2000	0.7	0.1
2001	0.8	0.1
2002	0.8	0.1
2003	0.7	0.1
2004	0.8	0.1
2005	0.8	0.1
2006	0.7	0.1
2007	0.8	0.1
2008	0.8	0.1
2009	1.0	0.1
2010	0.9	0.1

APPENDIX TABLE 4

Standard errors for table 2: Average annual burglaries or other property crimes involving the theft of at least one firearm, by theft characteristic, 2005–2010

	Burglary		Other property crimes	
Theft characteristic	Number	Percent	Number	Percent
Number of firearms stolen	22,938	~%	16,531	~%
Victimizations by stolen item	16,318	~%	15,628	~%
Firearm only	8,059	3.2	10,467	5.9
Firearm and at least one other item	14,035	3.3	11,427	5.9
Victimizations by type of stolen firearm				
Handgun	10,674	3.7%	12,664	5.6%
Other firearm	9,812	3.6	8,738	5.5
Both	6,956	2.9	1,904	1.4
Victimizations by number of stolen firearms				
One	11,901	3.7%	13,640	5.0%
More than one	10,071	3.6	5,926	4.2
Unknown	4,091	1.8	4,425	3.2

~Not applicable.

APPENDIX TABLE 5

Standard errors for table 3: Loss attributed to burglaries or other property crimes involving the theft of at least one firearm, by stolen item, 2005–2010

Stolen item	Burglary	Other property crimes
One firearm only and no other items		
Mean	$1,218	$1,261
Median	$1,053	$1,132
Average annual total	$171,515	$205,497
More than one firearm and no other items		
Mean	$2,825	$1,927
Median	$1,491	$1,534
Average annual total	$205,244	$117,730
One or more firearms and other items		
Mean	$4,631	$4,528
Median	$2,899	$2,934
Average annual total	…	…

…Not available.

APPENDIX TABLE 6

Standard errors for table 4: Percent of burglaries or other property crimes involving theft reported to police, by theft characteristic, 2005–2010

	Burglary		Other property crimes	
Theft characteristic	Number	Percent reported to police	Number	Percent reported to police
Victimizations by stolen item	16,318	2.6%	15,628	5.1%
Firearm only	8,059	6.0	10,467	8.3
Firearm and at least one other item	14,035	2.8	11,427	5.8
Victimizations by type of stolen firearm				
Handgun	10,674	3.2%	12,664	5.6%
Other firearm	9,812	5.2	8,738	9.9
Both	6,956	4.1	1,904	45.2
Victimizations by number of stolen firearms				
One	11,901	3.8%	13,640	5.9%
More than one	10,071	3.5	5,926	11.5
Unknown	4,091	9.9	4,425	16.7
Victimizations involving other theft by loss	83,191	0.9%	264,047	0.5%
$0–$99	84,912	1.7	399,809	0.6
$100–$499	118,079	1.5	394,853	0.8
$500–$999	80,080	2.1	181,906	1.6
$1,000 or more	125,828	1.1	234,504	1.1

APPENDIX TABLE 7

Standard errors for table 5: Average annual recovery of items stolen during burglaries or other property crimes, 2005–2010

	Burglary		Other property crimes	
	Number	Percent	Number	Percent
Number of stolen firearms	22,938	~%	16,531	~%
Recovered	5,070	2.9	3,781	6.1
Not recovered	20,212	5.3	15,289	9.4
Unknown	8,978	4.7	4,739	7.5
Victimizations involving a stolen firearm	16,317	~%	15,628	~%
All items recovered	3,313	1.5	3,634	2.7
Some items recovered	5,070	2.2	4,521	3.3
No items recovered	14,801	2.8	14,343	4.3
Unknown	2,585	1.2	1,520	1.1
Victimizations involving other stolen items	92,140	~%	293,782	~%
All items recovered	16,790	0.3	70,757	0.2
Some items recovered	16,190	0.3	51,566	0.2
No items recovered	86,447	0.5	267,959	0.4
Unknown	14,517	0.3	61,028	0.2

~Not applicable.

APPENDIX TABLE 8

Standard errors for table 6: Characteristics of households that experienced burglary or other property crimes involving the theft at least one firearm, 2005–2010

Household characteristic	All households	Burglary		Other property crimes	
		Firearm theft	Other theft	Firearm theft	Other theft
Household structure	~%	~%	~%	~%	~%
Two or more adults					
Without children	0.2	3.7	0.8	5.9	0.5
With children	0.1	2.7	0.5	3.9	0.4
One male adult					
Without children	0.1	3.1	0.5	4.6	0.3
With children	0.0	1.6	0.2	1.9	0.1
One female adult					
Without children	0.2	2.0	0.5	3.0	0.3
With children	0.1	1.4	0.5	2.2	0.2
Race and Hispanic origin	~%	~%	~%	~%	~%
White*	0.2	3.2	0.8	4.9	0.5
Black/African American*	0.1	2.5	0.6	4.0	0.3
Hispanic/Latino	0.1	1.8	0.5	2.7	0.3
American Indian/Alaska Native*	0.0	1.0	0.2	1.2	0.1
Asian/Native Hawaiian/ other Pacific Islander*	0.1	0.8	0.2	~	0.1
Two or more races*	0.0	0.8	0.2	1.4	0.1
Household income	~%	~%	~%	~%	~%
Less than $25,000	0.2	3.0	0.7	4.8	0.4
$25,000–$49,999	0.2	3.0	0.7	5.1	0.4
$50,000 or more	0.2	3.4	0.7	5.5	0.5
Not reported	0.2	3.4	0.7	4.8	0.4
Location of residence	~%	~%	~%	~%	~%
Urban	0.2	3.1	0.8	5.3	0.5
Suburban	0.2	3.7	0.8	5.9	0.5
Rural	0.2	3.5	0.6	4.8	0.3
Region	~%	~%	~%	~%	~%
Northeast	0.2	1.4	0.5	2.8 !	0.3
Midwest	0.2	2.9	0.7	4.3	0.4
South	0.2	3.7	0.8	5.8	0.5
West	0.2	3.0	0.7	4.6	0.4

*Excludes persons of Hispanic or Latino origin.

~Not applicable.

APPENDIX TABLE 9

Standard errors for figure 3: Rate of burglaries or other property crimes involving firearm theft, by General Social Survey (GSS) and Gallup poll estimates of household gun ownership, 1994–2010

	Rate per 1,000 gun-owning households			
	Burglary		Other property crimes	
Year	GSS	Gallup	GSS	Gallup
1994	0.5	0.5	0.7	0.7
1995	0.5	~	0.6	~
1996	0.5	0.5	0.6	0.6
1997	0.5	0.5	0.7	0.7
1998	0.5	~	0.7	~
1999	0.6	0.5	0.8	0.8
2000	0.6	0.6	0.8	0.7
2001	0.6	0.5	0.9	0.9
2002	0.6	0.5	0.9	0.9
2003	0.7	0.7	0.8	0.8
2004	0.7	0.6	0.9	0.8
2005	0.7	0.6	0.9	0.9
2006	0.7	0.7	0.8	0.8
2007	0.7	0.7	0.8	0.8
2008	0.7	0.6	0.8	0.8
2009	0.7	0.6	0.9	0.9
2010	0.6	0.6	1.0	1.0

Note: Computed by pooling variances of the NCVS estimates of number of households and GSS and Gallup estimates of percent of gun-owning households.

~Not applicable.

The Bureau of Justice Statistics is the statistical agency of the U.S. Department of Justice. James P. Lynch is the director.

This report was written by BJS statistician Lynn Langton. Matthew Durose verified the report.

Morgan Young, Jill Thomas, and Brian Higgins (Lockheed Martin) edited the report, and Tina Dorsey and Morgan Young produced the report, under the supervision of Doris J. James.

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EXHIBIT 62

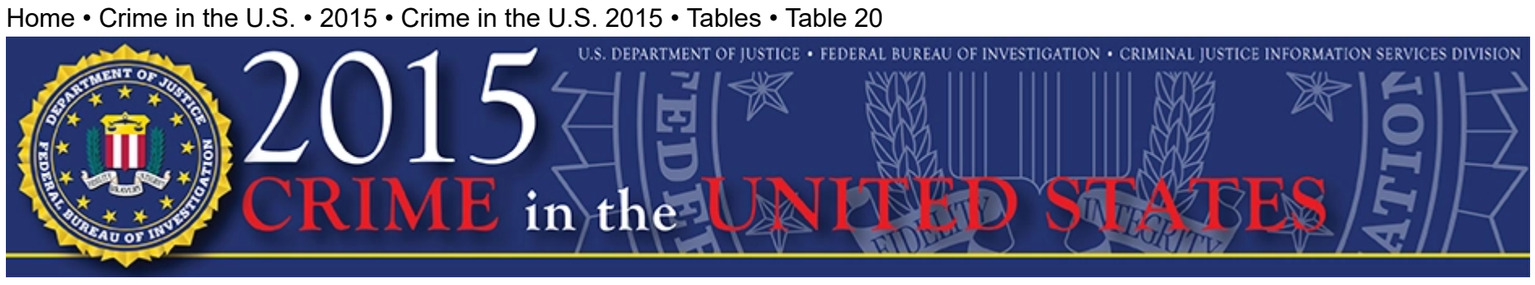

Table 20

Murder
by State, Types of Weapons, 2015

Data Declaration Download Excel

State	Total murders[1]	Total firearms	Handguns	Rifles	Shotguns	Firearms (type unknown)	Knives or cutting instruments	Other weapons	Hands, fists, feet, etc.[2]
Alabama[3]	3	3	1	0	1	1	0	0	0
Alaska	57	39	12	2	1	24	7	8	3
Arizona	278	171	128	4	3	36	42	55	10
Arkansas	164	110	51	10	4	45	18	30	6
California	1,861	1,275	855	34	33	353	263	233	90
Colorado	176	115	65	12	6	32	25	19	17
Connecticut	107	73	29	0	2	42	16	9	9
Delaware	63	52	26	0	0	26	6	3	2
District of Columbia	162	121	65	1	0	55	28	8	5
Georgia	565	464	394	16	10	44	38	60	3
Hawaii	19	4	1	1	0	2	6	2	7
Idaho	30	24	17	4	0	3	3	3	0
Illinois[3]	497	440	431	2	1	6	29	25	3
Indiana	272	209	147	9	5	48	22	29	12
Iowa	72	49	31	0	2	16	10	5	8
Kansas	125	91	51	4	4	32	9	14	11
Kentucky	209	141	91	1	9	40	30	26	12
Louisiana	474	379	207	7	9	156	46	43	6
Maine	23	16	15	0	0	1	3	1	3
Maryland	372	279	266	3	3	7	44	33	16
Massachusetts	126	81	33	1	0	47	27	11	7
Michigan	571	389	148	10	10	221	52	103	27
Minnesota	133	79	47	6	9	17	21	23	10
Mississippi	159	126	102	3	5	16	11	14	8
Missouri	499	418	233	12	11	162	26	40	15
Montana	36	18	13	0	0	5	8	3	7
Nebraska	61	43	41	1	1	0	9	8	1
Nevada	177	113	17	1	1	94	25	30	9
New Hampshire	14	8	4	0	0	4	6	0	0
New Jersey	353	255	200	3	0	52	38	41	19
New Mexico	94	56	14	1	2	39	18	19	1
New York	611	383	331	1	5	46	104	104	20
North Carolina	506	353	235	10	21	87	41	77	35
North Dakota	17	9	5	0	0	4	3	1	4
Ohio	480	316	184	12	7	113	39	103	22
Oklahoma	233	149	113	8	9	19	33	32	19
Oregon	71	34	17	1	5	11	12	22	3
Pennsylvania	651	497	386	10	11	90	65	67	22
Rhode Island	27	10	3	0	1	6	10	6	1
South Carolina	394	312	201	7	10	94	34	34	14
South Dakota	27	12	5	1	5	1	8	2	5
Tennessee	402	297	204	13	7	73	40	51	14
Texas	1,276	906	610	19	36	241	146	135	89
Utah	54	34	26	2	0	6	5	6	9
Vermont	10	8	2	4	0	2	0	1	1
Virginia	383	275	148	6	7	114	51	43	14
Washington	209	141	84	3	5	49	18	36	14
West Virginia	57	30	19	1	1	9	6	17	4
Wisconsin	238	170	122	5	4	39	37	25	6
Wyoming	16	10	4	0	3	3	2	3	1
Guam	6	3	1	0	0	2	1	2	0
U.S. Virgin Islands	35	26	12	1	0	13	3	6	0

- [1] Total number of murders for which supplemental homicide data were received.
- [2] Pushed is included in hands, fists, feet, etc.
- [3] Limited supplemental homicide data were received.

Data Declaration

Provides the methodology used in constructing this table and other pertinent information about this table.

Table 12

Murder
by State, Types of Weapons, 2016

Data Declaration Download Excel

State	Total murders[1]	Total firearms	Handguns	Rifles	Shotguns	Firearms (type unknown)	Knives or cutting instruments	Other weapons	Hands, fists, feet, etc.[2]
Alabama[3]	3	1	0	0	0	1	0	2	0
Alaska	52	43	12	4	1	26	3	6	0
Arizona	336	227	156	16	10	45	40	63	6
Arkansas	209	151	72	11	3	65	25	25	8
California	1,930	1,368	930	37	36	365	280	193	89
Colorado	202	136	87	4	4	41	27	28	11
Connecticut	76	48	24	0	1	23	12	13	3
Delaware	56	41	17	0	0	24	7	8	0
District of Columbia	136	105	105	0	0	0	19	6	6
Georgia	646	522	421	20	14	67	48	71	5
Hawaii	35	19	12	3	2	2	8	5	3
Idaho	47	17	13	1	0	3	5	21	4
Illinois[3]	941	799	728	14	5	52	61	62	19
Indiana	348	287	169	12	2	104	19	32	10
Iowa	71	43	25	2	1	15	12	10	6
Kansas	96	61	43	5	1	12	8	19	8
Kentucky	260	207	143	7	8	49	20	22	11
Louisiana	543	445	219	26	7	193	33	52	13
Maine	20	11	2	1	3	5	5	2	2
Maryland	430	328	309	2	3	14	52	29	21
Massachusetts	132	85	34	0	0	51	25	11	11
Michigan	597	443	191	15	12	225	45	89	20
Minnesota	99	60	42	2	1	15	12	19	8
Mississippi	154	128	101	4	6	17	4	14	8
Missouri	535	437	211	23	6	197	37	50	11
Montana	34	17	6	4	3	4	9	5	3
Nebraska	41	30	30	0	0	0	9	2	0
Nevada	209	141	21	2	0	118	20	42	6
New Hampshire	16	8	4	1	1	2	2	0	6
New Jersey	372	278	212	1	3	62	29	42	23
New Mexico	99	60	13	1	0	46	17	19	3
New York	628	367	305	2	9	51	130	99	32
North Carolina	595	421	262	20	22	117	50	80	44
North Dakota	14	8	5	2	0	1	3	1	2
Ohio	627	452	197	7	8	240	39	104	32
Oklahoma	243	171	135	9	9	18	31	23	18
Oregon	100	51	32	6	1	12	24	24	1
Pennsylvania	655	486	395	10	12	69	68	78	23
Rhode Island	29	12	5	0	0	7	9	6	2
South Carolina	363	281	172	7	9	93	29	36	17
South Dakota	21	7	7	0	0	0	5	4	5
Tennessee	486	356	202	10	7	137	49	69	12
Texas	1,459	1,066	630	51	31	354	175	136	82
Utah	71	42	31	1	0	10	6	20	3
Vermont	14	6	2	2	1	1	2	6	0
Virginia	482	352	151	10	10	181	33	67	30
Washington	195	127	69	11	5	42	19	38	11
West Virginia	76	47	30	2	0	15	4	21	4
Wisconsin	226	166	119	6	4	37	27	21	12
Wyoming	19	6	1	0	1	4	8	3	2
U.S. Virgin Islands	42	34	3	0	0	31	0	8	0

- [1] Total number of murders for which supplemental homicide data were received.
- [2] Pushed is included in hands, fists, feet, etc.
- [3] Limited supplemental homicide data were received.

Data Declaration

Provides the methodology used in constructing this table and other pertinent information about this table.

Table 20

Murder
by State, Types of Weapons, 2017

Data Declaration Download Excel

State	Total murders[1]	Total firearms	Handguns	Rifles	Shotguns	Firearms (type unknown)	Knives or cutting instruments	Other weapons	Hands, fists, feet, etc.[2]
Alabama[3]	2	1	0	0	0	1	0	1	0
Alaska	62	37	7	3	3	24	13	8	4
Arizona	404	249	162	8	9	70	50	93	12
Arkansas	250	168	92	11	4	61	23	52	7
California	1,830	1,274	886	37	34	317	258	195	103
Colorado	218	137	88	7	4	38	37	22	22
Connecticut	102	72	30	0	1	41	11	9	10
Delaware	52	44	20	0	1	23	3	4	1
District of Columbia	116	90	89	0	0	1	15	5	6
Georgia	672	542	490	15	5	32	37	85	8
Hawaii	39	4	1	1	0	2	9	10	16
Idaho	28	13	8	4	1	0	6	3	6
Illinois[3]	814	693	596	24	3	70	53	50	18
Indiana	360	291	147	14	6	124	20	39	10
Iowa	100	57	25	1	5	26	18	18	7
Kansas	129	79	44	4	7	24	16	26	8
Kentucky	263	192	128	6	6	52	25	33	13
Louisiana	566	460	216	23	12	209	46	42	18
Maine	23	12	4	0	0	8	3	4	4
Maryland	475	370	339	5	3	23	44	50	11
Massachusetts	170	99	34	0	0	65	36	29	6
Michigan	567	381	185	13	12	171	55	101	30
Minnesota	113	69	58	1	2	8	14	23	7
Mississippi	149	111	90	4	3	14	12	20	6
Missouri	596	514	224	22	8	260	25	48	9
Montana	41	17	10	2	1	4	12	5	7
Nebraska	43	31	27	2	2	0	4	5	3
Nevada	270	201	16	58	0	127	28	30	11
New Hampshire	14	7	4	0	1	2	5	1	1
New Jersey	324	242	175	7	4	56	42	29	11
New Mexico	113	71	20	2	0	49	20	19	3
New York	547	292	233	6	9	44	113	91	51
North Carolina	547	413	279	9	26	99	33	64	37
North Dakota	9	5	2	1	0	2	1	2	1
Ohio	682	485	226	5	11	243	46	128	23
Oklahoma	239	163	131	5	5	22	25	32	19
Oregon	100	58	34	2	2	20	17	22	3
Pennsylvania	735	567	452	11	8	96	63	73	32
Rhode Island	20	8	1	0	0	7	4	5	3
South Carolina	387	312	183	11	8	110	29	36	10
South Dakota	21	8	6	0	0	2	7	2	4
Tennessee	525	407	271	19	11	106	42	64	12
Texas	1,364	1,012	594	40	26	352	156	131	65
Utah	73	46	32	0	3	11	7	12	8
Vermont	14	6	1	0	0	5	6	1	1
Virginia	453	338	156	11	11	160	44	54	17
Washington	228	134	75	1	1	57	36	40	18
West Virginia	79	45	25	4	4	12	8	23	3
Wisconsin	186	149	111	4	2	32	11	17	9
Wyoming	14	6	5	0	0	1	3	3	2
Guam	1	0	0	0	0	0	0	1	0

- [1] Total number of murders for which supplemental homicide data were received.
- [2] Pushed is included in hands, fists, feet, etc.
- [3] Limited supplemental homicide data were received.

Data Declaration

Provides the methodology used in constructing this table and other pertinent information about this table.

Table 20

Murder
by State, Types of Weapons, 2018

Data Declaration Download Excel

State	Total murders[1]	Total firearms	Handguns	Rifles	Shotguns	Firearms (type unknown)	Knives or cutting instruments	Other weapons	Hands, fists, feet, etc.[2]
Alabama[3]	2	2	2	0	0	0	0	0	0
Alaska	47	31	7	3	0	21	8	3	5
Arizona	339	203	139	12	6	46	45	87	4
Arkansas	218	156	66	6	5	79	17	38	7
California	1,739	1,177	834	24	27	292	252	223	87
Colorado	207	147	99	2	8	38	27	13	20
Connecticut	83	54	10	2	0	42	18	9	2
Delaware	48	40	14	1	2	23	4	3	1
District of Columbia	151	120	120	0	0	0	20	7	4
Georgia	568	460	410	11	10	29	44	62	2
Hawaii	33	11	6	1	0	4	10	6	6
Idaho	32	19	14	2	2	1	4	8	1
Illinois[3]	864	708	592	14	4	98	77	53	26
Indiana	371	294	136	10	7	141	33	29	15
Iowa[4]	43	20	6	2	2	10	8	9	6
Kansas	110	78	47	0	2	29	7	19	6
Kentucky	237	179	112	12	6	49	17	32	9
Louisiana	521	436	233	12	5	186	30	44	11
Maine	23	11	6	0	1	4	2	6	4
Maryland	470	388	345	1	10	32	39	30	13
Massachusetts	136	93	37	0	1	55	25	13	5
Michigan	550	394	166	17	11	200	31	99	26
Minnesota	104	49	36	4	0	9	16	28	11
Mississippi	142	118	99	3	2	14	7	15	2
Missouri	555	473	235	16	9	213	40	32	10
Montana	34	17	9	3	0	5	2	12	3
Nebraska	43	26	22	0	1	3	5	9	3
Nevada	201	134	46	1	1	86	23	24	20
New Hampshire	21	12	6	0	0	6	3	4	2
New Jersey	286	202	152	0	2	48	37	28	19
New Mexico	137	87	39	3	0	45	23	22	5
New York	546	313	254	6	10	43	124	63	46
North Carolina	479	346	231	15	16	84	44	52	37
North Dakota	16	9	8	0	0	1	1	1	5
Ohio	546	383	184	3	7	189	49	87	27
Oklahoma	202	134	95	7	3	29	28	29	11
Oregon	81	48	30	3	1	14	12	18	3
Pennsylvania	787	580	464	17	7	92	83	99	25
Rhode Island	16	12	1	1	1	9	2	1	1
South Carolina	386	296	188	8	6	94	29	42	19
South Dakota	13	8	5	0	0	3	4	1	0
Tennessee	496	397	245	26	8	118	28	49	22
Texas	1,301	956	522	33	37	364	128	133	84
Utah	59	28	17	1	0	10	12	10	9
Vermont	10	3	3	0	0	0	0	5	2
Virginia	391	297	141	8	5	143	30	49	15
Washington	232	138	76	2	5	55	45	35	14
West Virginia	57	34	21	1	1	11	5	14	4
Wisconsin	178	136	67	4	2	63	15	16	11
Wyoming	12	8	6	0	2	0	2	0	2

- [1] Total number of murders for which supplemental homicide data were received.
- [2] Pushed is included in hands, fists, feet, etc.
- [3] Limited supplemental homicide data were received.
- [4] Limited data for 2018 were available for Iowa.

Data Declaration

Provides the methodology used in constructing this table and other pertinent information about this table.

Table 20

Murder

by State, Types of Weapons, 2019

Data Declaration Download Excel

State	Total murders[1]	Total firearms	Handguns	Rifles	Shotguns	Firearms (type unknown)	Knives or cutting instruments	Other weapons	Hands, fists, feet, etc.[2]
Alabama[3]	4	3	3	0	0	0	0	1	0
Alaska	69	44	17	1	6	20	8	5	12
Arizona	337	213	170	6	6	31	47	67	10
Arkansas	231	177	87	10	5	75	21	29	4
California	1,679	1,142	762	34	26	320	252	183	102
Colorado	209	135	83	5	3	44	32	30	12
Connecticut	104	65	11	1	0	53	15	17	7
Delaware	48	40	13	0	0	27	2	3	3
District of Columbia	166	136	52	0	0	84	18	2	10
Florida[4]	1	0	0	0	0	0	0	1	0
Georgia	445	367	305	14	3	45	34	35	9
Hawaii	32	9	5	0	0	4	7	11	5
Idaho	35	16	9	0	0	7	3	13	3
Illinois[5]	771	647	564	7	4	72	70	44	10
Indiana	247	185	118	3	1	63	25	29	8
Iowa	58	36	21	0	0	15	8	8	6
Kansas	93	56	37	1	0	18	12	13	12
Kentucky	221	174	101	9	5	59	23	20	4
Louisiana	522	433	200	21	3	209	24	54	11
Maine	20	13	6	0	3	4	2	4	1
Maryland	551	460	414	3	4	39	43	34	14
Massachusetts	146	86	33	0	0	53	38	14	8
Michigan	551	379	172	13	5	189	44	104	24
Minnesota	114	79	61	0	0	18	10	15	10
Mississippi	189	153	117	4	3	29	11	23	2
Missouri	566	486	255	26	10	195	31	37	12
Montana	27	16	11	1	1	3	4	4	3
Nebraska	45	35	26	2	2	5	2	4	4
Nevada	147	94	49	5	3	37	20	23	10
New Hampshire	33	16	12	0	0	4	5	7	5
New Jersey	262	176	118	2	1	55	45	25	16
New Mexico	146	96	51	1	3	41	21	24	5
New York	550	298	255	3	5	35	119	89	44
North Carolina	516	383	224	26	8	125	52	68	13
North Dakota	26	13	5	2	1	5	5	4	4
Ohio	521	382	178	13	3	188	26	88	25
Oklahoma	264	189	129	11	12	37	27	37	11
Oregon	98	61	31	1	4	25	19	14	4
Pennsylvania	556	429	350	11	11	57	46	66	15
Rhode Island	25	10	1	0	0	9	7	6	2
South Carolina	445	381	224	9	8	140	22	27	15
South Dakota	19	7	4	1	0	2	3	6	3
Tennessee	498	391	173	13	7	198	41	46	20
Texas	1,379	1,064	568	72	21	403	127	130	58
Utah	66	41	18	1	6	16	8	13	4
Vermont	11	8	3	2	0	3	0	1	2
Virginia	427	323	150	15	9	149	40	49	15
Washington	194	135	89	5	3	38	23	24	12
West Virginia	72	48	23	7	2	16	6	15	3
Wisconsin	178	119	53	3	3	60	25	27	7
Wyoming	13	9	7	0	0	2	3	0	1

- [1] Total number of murders for which supplemental homicide data were received.
- [2] Pushed is included in hands, fists, feet, etc.
- [3] Limited data for 2019 were available for Alabama.
- [4] Data submitted through the Bureau of Indian Affairs.
- [5] Limited supplemental homicide data were received.

Data Declaration

Provides the methodology used in constructing this table and other pertinent information about this table.

EXHIBIT 63

PBS NEWS HOUR

Mass shootings are rare – firearm suicides are much more common, and kill more Americans

Nation Mar 30, 2021 4:15 PM EDT

As the U.S. deals with two mass shootings in a single week, public outcry about racism, gun violence, gun rights and what to do about these issues is high. At last count, 10 people were **shot dead at a supermarket in Boulder, Colorado**, on March 22. Just days earlier, eight people were killed in a series of **shootings at spas in Atlanta, Georgia**.

As a **criminal justice researcher**, I study gun purchasing and mass shootings, and it's clear to me that these events are traumatic for victims, families, communities and the nation as a whole. But despite the despair about their slightly growing frequency, they are actually uncommon incidents that account for just **0.2% of firearm deaths** in the U.S. each year.

Mass shootings are rare

Killings are not the only kind of gun violence, and are in fact a relative rarity when compared with other forms of gun violence in the U.S. According to the **National Crime Victimization Survey**, 470,840 people were victims of crimes that involved a firearm in 2018, and 481,950 in 2019. Each person is counted separately, even if several of them were part of the same incident, and this tally does not require the gun to be fired or anyone to be killed.

When it comes to people killed by firearms, police data reported to the FBI estimates that guns were used in **10,258 of the 13,927 homicides** that occurred in 2019.

That's much higher than even the uppermost count of mass shootings in 2019, the **417 recorded by the Gun Violence Archive**. That group counts all incidents in which at least four people are shot, excluding the shooter, regardless of whether the shooter is killed or injured. It also includes events that involve gang violence or armed robbery, as well as shootings that occurred in public or in private homes, as many domestic violence shootings do.

A Mother Jones magazine database that defines mass shootings more restrictively **lists only 10** for 2019.

Even the FBI's own data – which uses **yet another set of criteria** focused on people who continue to shoot more people over the course of an incident – records just **28 active shooter incidents** in 2019.

The most recent research on frequency of mass shootings indicates **they are becoming more common**, though the exact number each year can vary widely.

But not all experts agree. Some argue that **mass shootings have not increased** and that reports of an increase are due to differences in research methods, such as determining which events are appropriate to count in the first place.

Speaking about school shootings specifically in a 2018 interview, two gun violence researchers said that **those events have not become more common** – but rather, people have become more aware of them.

The same may be true of mass shootings more generally. In any case, some researchers have found that **mass shootings are becoming more deadly**, with more victims in recent attacks.

Suicide is the leading form of gun death

In 2019, the 417 mass shootings tallied by the Gun Violence Archive **resulted in 465 deaths**.

By contrast, **14,414 people were killed** by someone else with a gun in 2019. And **23,941 people intentionally killed themselves** with a gun in 2019, according to the Centers for Disease Control and Prevention.

Every year, homicides – one person killing another – make up **about 35% of gun deaths**. More than 60% of gun deaths are suicides.

Mass shootings can get more attention than these other, more common, types of firearm deaths both because of human nature and the news media. People are naturally curious about violent events that appear random, with no clear explanation. Those incidents often spark fears about whether similar things could happen to them, and a resulting desire to know more in an effort to understand.

In addition, cases with higher death counts or unusual characteristics, such as a **shooter manifesto** or video footage, are **more likely to get press attention** and extended coverage.

Americans' opinions are split on whether mass shootings are **isolated incidents or part of a broader societal problem**.

And Americans are divided about how to reduce their frequency. A 2017 poll found that 47% of adults believed that **reducing the number of guns** in the U.S. would reduce the number of mass shootings. But a follow-up question revealed that **75% of American adults** believe that someone who wants to hurt or kill others will find a way to do it whether they have access to a firearm or not.

With those diverging views, it will be hard to develop solutions that will be effective nationwide. That doesn't mean **nothing will change**, but it does mean the political debates will likely continue.

By – **Lacey Wallace, The Conversation**

Lacey Wallace is an assistant professor of criminal justice at Penn State.

EXHIBIT 64

UC DAVIS HEALTH (/welcome/)

Facts and Figures

The human toll

There were 39,707 deaths from firearms in the U.S. in 2019. Sixty percent of deaths from firearms in the U.S. are suicides. In 2019, 23,941 people in the U.S. died by firearm suicide.[1] Firearms are the means in approximately half of suicides nationwide.

In 2019, 14,861 people in the U.S. died from firearm homicide, accounting for 37% of total deaths from firearms. Firearms were the means for about 75% of homicides in 2018.

The other 3% of firearm deaths are unintentional, undetermined, from legal intervention, or from public mass shootings (0.2% of total firearm deaths).

There are approximately 115,000 non-fatal firearm injuries in the U.S. each year.

The economic cost

The estimated annual cost of gun injury in 2012 **exceeded $229 billion**—about **1.4%** of GDP.[2]

Prevalence of ownership

31% of all households in the U.S. have firearms, and **22%** of American adults personally own one or more firearms.[3]

Compared with other countries

The U.S. has **relatively low rates** of assaultive violence but high firearm mortality rates in comparison with other industrialized nations.[4]

Risk and safety

Research has found that individuals with risk factors for firearm injury and death are **less likely to safely store their firearms** when compared to firearm owners without these risk factors.[5,6]

Trends in firearm injury and death

Overall since 2006, firearm homicides in the U.S. have decreased, but the number of firearm suicides has increased by a similar amount.[4]

Even when firearm homicide rates were at their highest in the mid-1990s (just above 7/100,000 population), they were not higher than those for firearm suicide.

Firearm homicide and suicide rates vary demographically and geographically.

Learn more about **trends in firearm injury and death (/what-you-can-do/trends-in-firearm-injury.html)** in the U.S.

The role of health care providers

There are **no state or federal statutes** that prohibit health care providers from asking about patients' access to firearms when the information is relevant to the health of the patient or the health of someone else.[7,8]

Research has shown that **patients are generally receptive to provider questions** on firearm access and safety.[9,10]

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1. Web-based Injury Statistics Query and Reporting System (https://www.cdc.gov/injury/wisqars/index.html) (WISQARS). Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2018.
2. Follman M, Lurie J, Lee J, West J. The true cost of gun violence in America. 2015. (Accessed 10 December, 2017, at https://www.motherjones.com/politics/2015/04/true-cost-of-gun-violence-in-america/ (https://www.motherjones.com/politics/2015/04/true-cost-of-gun-violence-in-america/))
3. Smith TW, Son J. General Social Survey final report: trends in gun ownership in the United States, 1972-2014 (http://www.norc.org/PDFs/GSS%20Reports/GSS_Trends%20in%20Gun%20Ownership_US_1972-2014.pdf). 2015.
4. Wintemute GJ. The epidemiology of firearm violence in the twenty-first century United States (https://www.ncbi.nlm.nih.gov/pubmed/25533263). Annu Rev Public Health 2015;36:5-19.
5. Nelson DE, Grant-Worley JA, Powell K, Mercy J, Holtzman D. Population estimates of household firearm storage practices and firearm carrying in Oregon (https://www.ncbi.nlm.nih.gov/pubmed/?term=Population+estimates+of+household+firearm+storage+practices+and+firearm+carrying+in+Oregon). JAMA 1996;275:1744-8.
6. Nordstrom DL, Zwerling C, Stromquist AM, Burmeister LF, Merchant JA. Rural population survey of behavioral and demographic risk factors for loaded firearms (https://www.ncbi.nlm.nih.gov/pubmed/11428557). Inj Prev 2001;7:112-6.
7. Wintemute GJ, Betz ME, Ranney ML. Yes, you can: physicians, patients, and firearms (http://annals.org/aim/fullarticle/2522436/yes-you-can-physicians-patients-firearms). Ann Intern Med

2016;165:205-13.
8. Kapp MB. Geriatric patients, firearms, and physicians (http://annals.org/aim/fullarticle/1707739/geriatric-patients-firearms-physicians). Ann Intern Med 2013;159:421-2.
9. Betz ME, Flaten HK, Miller M. Older adult openness to physician questioning about firearms (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5677182/). J Am Geriatr Soc 2015;63:2214-5.
10. Walters H, Kulkarni M, Forman J, Roeder K, Travis J, Valenstein M. Feasibility and acceptability of interventions to delay gun access in VA mental health settings (https://www.ncbi.nlm.nih.gov/pubmed/22959420). Gen Hosp Psychiatry 2012;34:692-8.

EXHIBIT 65

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Post-traumatic stress disorder following disasters: a systematic review

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Abstract

Background—Disasters are traumatic events that may result in a wide range of mental and physical health consequences. Post-traumatic stress disorder (PTSD) is probably the most commonly studied post-disaster psychiatric disorder. This review aimed to systematically assess the evidence about PTSD following exposure to disasters.

Method—A systematic search was performed. Eligible studies for this review included reports based on the DSM criteria of PTSD symptoms. The time-frame for inclusion of reports in this review is from 1980 (when PTSD was first introduced in DSM-III) and February 2007 when the literature search for this examination was terminated.

Results—We identified 284 reports of PTSD following disasters published in peer-reviewed journals since 1980. We categorized them according to the following classification: (1) human-made disasters (n=90), (2) technological disasters (n=65), and (3) natural disasters (n=116). Since some studies reported on findings from mixed samples (e.g. survivors of flooding and chemical contamination) we grouped these studies together (n=13).

Conclusions—The body of research conducted after disasters in the past three decades suggests that the burden of PTSD among persons exposed to disasters is substantial. Post-disaster PTSD is associated with a range of correlates including sociodemographic and background factors, event exposure characteristics, social support factors and personality traits. Relatively few studies have

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Note
Supplementary information accompanies this paper on the Journal's website (http://journals.cambridge.org).

Declaration of Interest
None.

employed longitudinal assessments enabling documentation of the course of PTSD. Methodological limitations and future directions for research in this field are discussed.

Keywords

Disaster; post-traumatic stress disorder (PTSD); trauma

Introduction

Exposure to traumatic events is common. Studies have shown that more than two thirds of the general population are likely to be exposed to trauma in their lifespan and up to one fifth of Americans may experience traumatic events in the USA in any given year (Breslau *et al.* 1991, 1998; Norris, 1992; Resnick *et al.* 1993; Kessler *et al.* 1995). However, there is substantial heterogeneity worldwide in the distribution of exposure to traumatic events. Research suggests that there are certain geographical areas where large populations are consistently exposed to large-scale traumatic events such as wars, organized violence, terrorism, and natural disasters. Therefore, the overall exposure to trauma worldwide may exceed rates previously reported in the USA (Kessler, 2000; Brunello *et al.* 2001).

Exposure to disasters is particularly common. A national survey in the USA suggested that more than 15% of females and 19% of males were exposed to disasters at some time in their lifetime (Kessler *et al.* 1995). Although the consequences of disasters may include a wide range of psychopathology (Norris *et al.* 2002; Neria *et al.* 2006a), previous systematic reviews have documented that post-traumatic stress disorder (PTSD) is the most commonly studied psychopathology in the aftermath of disasters (Norris *et al.* 2002; Galea *et al.* 2005) and is likely the central psychopathology after such events (Breslau *et al.* 2002).

The purpose of this article is to review the literature on PTSD following disasters starting from 1980, when PTSD was first presented in DSM-III (APA, 1980) as a psychiatric condition to February 2007, when this review was terminated. This review builds on previously published reviews related to the topic (Norris *et al.* 2002; Galea *et al.* 2005), updates and expands this prior work, and aims to identify key challenges in the extant literature.

Method

Selection criteria

The sampling frame for this review can be summarized based on exposure, outcome, and time-frame. There is little consensus in the literature about what constitutes a disaster. For the purpose of this review, following the example established in a previous review (Galea *et al.* 2005), we considered studies about disasters that were defined as such by their authors. Studies assessing the impact of chronic exposure to trauma (e.g. war) were generally not included in this review. For the outcome, studies eligible for this review included reports based on DSM criteria of PTSD symptoms. Therefore, studies of other psychiatric disorders (e.g. depression, substance abuse) or psychological problems (e.g. unresolved grief) were not included in this review. The time-frame for inclusion of reports in this review was

between 1980 (when PTSD was first introduced in DSM-III) and February 2007 when the literature search for this examination was terminated.

Search strategy

We obtained papers for this review using a four-step procedure. First, we performed a systematic search of the peer-reviewed literature using the Medline, PsycINFO, and PILOTS databases and identified potential studies for inclusion using the following keywords: 'PTSD', 'posttraumatic stress disorder', 'disaster', 'mental health', 'trauma'. Second, we analyzed abstracts for all studies identified and excluded papers that did not satisfy selection criteria. Third, we analyzed the full-text version of all remaining studies and excluded those that did not satisfy selection criteria. Finally, we compared our final sample to previous review papers (Brewin *et al.* 2000; Norris *et al.* 2002; Galea *et al.* 2005) to verify that our search was successful and its results were comprehensive.

Search results

Our search identified 284 reports of PTSD following disasters published since 1980. The earliest disaster included in this review was the 1963 Vajont landslide and tidal wave flood disaster in Northeast Italy, which was studied retrospectively 36 years after and reported in 2004 (Favaro *et al.* 2004), and the latest disaster studied was Hurricane Katrina in 2005, most recently described in a report by the Centers for Disease Control and Prevention (CDC, 2006). We categorized studies according to the following classification: (1) human-made disasters (n=90), (2) technological disasters (n=65), and (3) natural disasters (n=116). Because some studies reported on findings from mixed samples (e.g. survivors of flooding and chemical contamination) we grouped these studies together (n=13). Hence, the results of this review are presented in four Appendix tables (Tables A1–A4, available in the online version of this paper). Each table provides a summary including lead author and year of publication, study design (cross-sectional, prospective cohort), population studied (survivors, responders, community or the general population, mixed), subjects' roles (e.g. disaster workers), sampling method (convenience sample, systematic sample), time-frame of data collection, PTSD instrument, and main findings. Key reports that made use of a random or systematic sample and that studied at least 500 participants are summarized by disaster type in text Tables 1–3. These tables aim to provide the reader with main findings and comparisons between disaster types, populations studied, and time-frames of assessments to facilitate the most meaningful conclusions from the numerous studies conducted in almost three decades of research.

Findings

Although many reports of rates of post-disaster PTSD can use the term 'incidence' rather than 'prevalence' due to the fact that in most cases the exposure duration was brief and limited in time, few studies were designed to ensure that the assessment of incidence was carried out among persons without previous PTSD. We therefore, and consistent with a previous review (Galea *et al.* 2005), opted to use the term 'prevalence' rather than 'incidence' throughout this article unless incidence of PTSD was specifically assessed in individuals without pre-disaster PTSD.

Studies of human-made disasters

Table A1 presents data on human-made disasters reviewed. We located 22 human-made disasters, on which 90 reports have been published. The most frequently studied events were the 11 September 2001 terrorist attacks (*n*=42) and the 1995 Oklahoma City bombing (*n*=15). Of those studies, we present 12 key studies in Table 1.

Prevalence—Most studies in this category assessed PTSD in adult populations. The highest prevalence of PTSD was found among survivors and first responders. For example, 1 month after exposure, PTSD prevalence ranged from 20.3% among survivors of the 1993 Sivas religious uprisings in Turkey (Sungur & Kaya, 2001) to 29% among survivors of the 1991 mass shooting episode in Killeen, Texas (North *et al.* 1994). The prevalence of PTSD among first responders assessed following involvement in rescue, recovery and cleaning efforts were especially high. For example 44.3% of police officers involved in the 1989 Hillsborough football stadium disaster in Sheffield, UK, assessed 1–2 years after exposure (Sims & Sims, 1998), were classified with severe symptom severity while 44.1% were classified with moderate symptom severity. Similarly, 22.5% and 20% of disaster workers were found to suffer from PTSD at 2 weeks and 10–15 months after the 9/11 terrorist attacks in New York City and Washington, DC, respectively (CDC, 2004; Fullerton *et al.* 2006).

There are relatively few examples of research based on probability samples of the general population. Only one such study preceded the attacks of 11 September 2001. Using a household probability sample of adults from Los Angeles County (*n*=1200), Hanson and colleagues (Hanson *et al.* 1995) estimated that the prevalence of current (past 6 months) PTSD was 4.1% 6–8 months after the 1992 Los Angeles County civil disturbances. Subsequent work including general population samples of adults from New York City and the New York City metropolitan areas after the 9/11 attacks (Galea *et al.* 2004; Adams & Boscarino, 2005; Nandi *et al.* 2005; Stuber *et al.* 2006) and from Madrid after the 2004 train bombings (Miguel-Tobal *et al.* 2006) showed comparable levels of PTSD symptoms within the first 12 months after these terrorist attacks.

Several studies after human-made disasters focused on specific populations such as low-income subjects and recent immigrants (Neria *et al.* 2006c), psychiatric patients (Franklin *et al.* 2002), specific ethnic groups (Murphy *et al.* 2003; Galea *et al.* 2004), and parents of children exposed to disasters (Mirzamani & Bolton, 2002). Because there are not enough studies in each group, it is not possible to compare between studies. However, it is noteworthy that these studies suggest that while the prevalence of PTSD is likely to decline over time in the general population, the impact of the trauma among high-risk groups may endure. For example, while the prevalence of PTSD declined among residents of Manhattan from 7.5% 1 month after the 9/11 terrorist attacks to 1.7% and 0.6% at 4 and 6 months after the 9/11 attacks, respectively (Galea *et al.* 2003), the prevalence of PTSD among low-income minorities 1 year after the terrorist attacks was substantially higher (10.2%) (Neria *et al.* 2006c).

Only 18 studies focused on samples of children. They studied samples exposed to the: 1984 school playground sniper attack in Los Angeles; 1988 school shooting in Winnetka, Illinois; 1993 World Trade Center bombing; 1995 Oklahoma City bombing; 1998 American

Embassy bombing in Nairobi, Kenya; 1998 discotheque fire in Goteborg, Sweden; and the 9/11 terrorist attacks in New York City and Washington, DC. Because the assessment measures that were used in these studies were different, and some studies chose to measure post-traumatic symptoms only, cross-study comparisons of the prevalence of PTSD in children is limited. Yet, the evidence suggests a particularly high prevalence of PTSD among directly exposed children. For example, the prevalence of PTSD among exposed children was 38.4% at 1 month after the 1984 school playground sniper attack in Los Angeles (Pynoos *et al.* 1987), 27% at 3 months after the 1993 World Trade Center bombing (Koplewicz *et al.* 2002), and 18.4% at 6 months after the 9/11 terrorist attacks in New York City (Hoven *et al.* 2005).

Course—A number of studies examined PTSD longitudinally, enabling documentation of the course of PTSD in samples exposed to human-made disasters. All studies provided evidence of a general decline in the prevalence of PTSD over time. For example, data from the 1991 mass shooting in Killeen, Texas, suggest that the prevalence of PTSD decreased from 27.2% at 6–8 weeks to 17.7% at 13–14 months after the episode (North *et al.* 1997). Findings from a large nationally representative sample of adults residing outside of New York City show that the prevalence of PTSD decreased from 17.0% at 2 months after 9/11 to 5.8% at 6 months after 9/11 (Silver *et al.* 2002). The same pattern has been observed in a random sample of adults living in Manhattan (Galea *et al.* 2003). Similarly, research among children directly exposed to the 1993 World Trade Center bombing suggests that the prevalence of severe to very severe PTSD symptomatology decreased from 27% at 3 months to 14% at 9 months (Koplewicz *et al.* 2002). It is noteworthy that no study to date has assessed the course of PTSD over a long enough period of time (e.g. years) to reliably examine whether PTSD monotonically declines over time or whether there is reliable evidence for the late onset of PTSD.

Studies of technological disasters

We identified 65 studies from 40 technological disasters, starting with the 1966 Aberfan mining disaster in South Wales and ending with the 2002 near sinking of the USS Dolphin Navy research submarine (Table A2). Of these studies, we present in Table 2 the three key studies based on probability samples of the general population conducted following the 1986 Chernobyl nuclear reactor accident (Havenaar *et al.* 1997), the 1989 *Exxon Valdez* oil spill (Palinkas *et al.* 1993), and the 2001 chemical factory explosion in France (Godeau *et al.* 2005).

Prevalence of PTSD—Many of the reports suggest a high prevalence of PTSD when survivors or rescue workers involved in technological disasters were assessed for the first time after exposure. The prevalence of PTSD following technological disasters ranged from 15% to 75%. For example, 15% of residents exposed to the 1991 toxic chemical railroad spill in California had PTSD at 3–4 months after the disaster (Freed *et al.* 1998). Similarly, 26% of adult survivors from the buildings most severely damaged by the 1992 Bijlmermeer plane crash in The Netherlands were found to have PTSD 6 months after the disaster (Carlier & Gersons, 1997). On the other extreme, 73% of survivors from the 1988 Piper

Alpha oil rig disaster were found to have PTSD when assessed 10 years after exposure (Hull *et al.* 2002).

Course of PTSD—A number of studies have conducted longitudinal assessments following exposure to technological disasters, enabling documentation of the course of PTSD symptoms. One study found a significant decline from 54% in the first month after an airplane crash-landing in Alabama to 10–15% one year after the disaster (Sloan, 1988). Similarly, rapid declines in the prevalence of PTSD over time were documented after the USS *Iowa* gun turret explosion (Ursano *et al.* 1995), the Piper Alpha oil rig disaster (Alexander, 1993), and the Lockerbie disaster (Scott *et al.* 1995).

Studies of natural disasters

Observations of studies of natural disasters confirm key observations from human-made and technological disasters. Hence, we will summarize key findings of PTSD after natural disasters while highlighting the main differences between types of disasters. We located 116 studies from 40 natural disasters starting with the 1963 Vajont landslide and tidal wave flood disaster in Northeast Italy and ending with Hurricane Katrina in August of 2005 (see Table A3 for further details about individual studies). From those studies we present in Table 3 findings from key studies.

Prevalence of PTSD—Consistent with previous observations (Norris *et al.* 2002; Galea *et al.* 2005) we note that the prevalence of PTSD documented in the aftermath of natural disasters is often lower than the rates documented after human-made and technological disasters. Large-scale natural disasters affect broad geographic areas, leading investigators to study mixed populations that often include both direct and indirect victims (Thompson *et al.* 1993; Shannon *et al.* 1994; Carr *et al.* 1995). Consequently, as previously suggested (Galea *et al.* 2005), the relatively low prevalence of PTSD among populations studied after natural disasters compared to human-made or technological disasters may stem from a lower average dosage of exposure among people exposed to the disaster. This is supported by a study of the Turkey earthquakes that showed a higher prevalence of PTSD closer to the epicenter compared to 100 km away (Basoglu *et al.* 2004). Overall studies of natural disasters report PTSD prevalence ranging from 3.7% (Canino *et al.* 1990) to 60% (Madakasira & O'Brien, 1987) in the first 1–2 years after the disaster, with most studies reporting prevalence estimates in the lower half of this range (Norris *et al.* 2004; Liu *et al.* 2006; Parslow *et al.* 2006). However, higher prevalence estimates of PTSD have been reported in specific groups such as clinical samples (Livanou *et al.* 2002; Soldatos *et al.* 2006) and populations in areas heavily affected by the disaster (Najarian *et al.* 2001; Finnsdottir & Elklit, 2002). Moreover, a study based on a community sample following the Turkey earthquakes estimated the prevalence of PTSD to be 11.7% even 3 years after the disaster (Onder *et al.* 2006).

Few studies examined PTSD among first responders, particularly firefighters and police officers in the wake of natural disasters (McFarlane, 1988; McFarlane & Papay, 1992; Spurrell & McFarlane, 1993; Chang *et al.* 2003; Ozen & Sir, 2004; Armagan *et al.* 2006; CDC, 2006). Those that did, generally showed high-prevalence estimates of PTSD. For

example, 21% of firefighters responding to the 1999 Chi-Chi earthquake in Taiwan (Chang *et al.* 2005) and 22% of firefighters responding to Hurricane Katrina in 2005 (CDC, 2006) had PTSD at 5 months and 2–3 months after the disaster, respectively.

A number of studies investigated PTSD among children following natural disasters. In the aftermath of the 1988 Armenian earthquake, 95% of the children from a severely exposed city and 26% of the children from a mildly exposed city had severe levels of PTSD symptoms 1.5 years after the event (Goenjian *et al.* 1995). The prevalence found among the mildly exposed children is comparable to the prevalence of PTSD among children exposed to the 1989 Loma Prieta earthquake (Bradburn, 1991), 1992 Hurricane Andrew (Vernberg *et al.* 1996), 1999 Hurricane Floyd (Russoniello *et al.* 2002), 2002 Typhoon Rusa (Lee *et al.* 2004), and the 2004 earthquake and tsunami (Neuner *et al.* 2006).

Course of PTSD—Few studies have examined the course of PTSD after natural disasters. A longitudinal study of firefighters who participated in rescue efforts after the 1983 Australian bushfire found that more than one-fifth of the sample (21%) had persistent PTSD over a 2-year period (McFarlane, 1988). This study extended extant knowledge about PTSD from human-made disasters by examining multiple patterns of PTSD, including acute onset (9.2%) and delayed onset (19.7%) PTSD. In parallel to findings from studies of human-made disasters, some longitudinal research of natural disasters documented a decline in PTSD prevalence over time (Carr *et al.* 1997a, b; van Griensven *et al.* 2006); however, some studies also showed an increase in PTSD prevalence over time. For example, a cohort study of residents of Dade County, Florida exposed to Hurricane Andrew in 1992 found that the prevalence of PTSD increased from 26% to 29% between 6 and 30 months after the disaster. More specifically, this study showed that while intrusion and arousal symptoms declined over time, avoidance symptoms increased (Norris *et al.* 1999). Similarly, an increase in prevalence of PTSD was observed between 3 and 9 months after the 1998 Zhangbei-Shangyi earthquake in China (Wang *et al.* 2000).

Multiple disaster aggregate studies

We identified 13 studies that included samples from more than one disaster (see Table A4 for a detailed description of these studies). While some studies investigated samples from the same disaster type, such as survivors from multiple terrorist attacks in France (Abenhaim *et al.* 1992; Verger *et al.* 2004), survivors from earthquakes in Santiago, Chile, and California, USA (Durkin, 1993), and survivors from the Oklahoma City bombing and the Nairobi bombing (North *et al.* 2005), other studies focused on survivors of different types of disasters, including a study that included subjects exposed to either a plane crash, tornado or shooting spree (Smith *et al.* 1993) and a study that included persons exposed to either a plane crash or train collision (Chung *et al.* 2005). One advantage of these studies is that they used the same instrument in different samples, facilitating comparisons. One study comparing different populations exposed to terrorist bombings (North *et al.* 2005) found lower rates of PTSD (22% among males and 40% among females) among survivors 6 months after the Oklahoma City bombing compared to survivors 8–10 months after the Nairobi bombing (34% among males and 49% among females). Only one study assessed the course of PTSD over time. Interestingly, while the prevalence of PTSD decreased over time

among earthquake survivors, it increased among survivors of political abuse between 1.5 and 4.5 years after exposure (Goenjian *et al.* 2000).

Discussion

Classification of disasters

The trauma literature has yet to provide a consistent distinction between individual traumatic events and disasters (which arguably are best considered as collectively experienced, or mass traumas), leaving the question what qualifies a traumatic event to meet criteria for a disaster open (Quarantelli, 1995). Earlier work in sociology and hazard and risk management has attempted to address this problem (Quarantelli, 1998; Mileti, 1999). It has been suggested that an incident is a disaster if it is extremely harmful and disruptive (Tierny *et al.* 2001). However, definitions of 'extremely' vary and there remains no universal or even widely used definition of disasters making for inconsistencies between studies in which events are considered as disasters by some studies, but not by others. For example, while massive loss of life seems to be central for an event to be classified as a disaster, some of the most studied disasters (e.g. Three Mile Island) did not result in any loss of life. Similarly, while the literature is generally unified in classification of events as disasters if they are disruptive events and restricted in time (e.g. plane crash, flood, fire), the status of ongoing repeated exposure to massive interpersonal trauma (e.g. Holocaust, ongoing ethnic cleansing, and genocide) is not clear. Although this review was not committed to a single definition of disaster, we suggest that a definitive definition of a disaster would need to account for at least two dimensions: scale and outcome (Norris *et al.* 2002; Galea & Resnick, 2005; Neria *et al.* 2006b). Hence, an incident may be appropriately classified as a disaster if its scale is 'large', i.e. it has affected a considerable number of people regardless of loss of life, and its consequences are 'significant', i.e. it has resulted in quantifiable mental and/or physical health outcomes among the affected population.

Measurement of PTSD—The classification of PTSD has been modified since it was first introduced in DSM-III in 1980. For example, in DSM-IV the definition of the A criterion was changed to include both exposure (A1) and the subjective response to the exposure (A2), and specifically whether the exposed person experienced horror and helplessness facing the exposure. Notably, compared to previous DSM editions, the recent DSM-IV definition of exposure is broader and provides a list of potential examples, which includes a sudden death of a close relative. Changes in definitions of PTSD may influence rates, correlates and course of PTSD as documented across studies over time. Moreover, while PTSD is a clinical condition, regularly assessed by clinical interviewers, many post-disaster studies have utilized screening instruments administered by laypersons or well trained research assistants. Although most screening instruments showed sufficient psychometric properties there is no evident agreement in the PTSD literature in general and the disaster literature in particular about what is the best screening instrument that can be reliably administered by laypersons in the aftermath of disasters. Similarly, there is a lack of consensus of whether a face-to-face interview is needed for a reliable assessment of post-disaster psychopathology or alternatively whether telephone-based (Galea *et al.* 2002) or

internet-based (Schlenger *et al.* 2002; Silver *et al.* 2002; Neria *et al.* 2007) surveys are similarly qualified to assess disaster-related PTSD.

Exposure and post-disaster PTSD—The role of event exposure in the development of PTSD has received considerable attention across studies. A wide range of potential types of exposure has been studied. Importantly, the risk of PTSD has been repeatedly shown to be associated with severity of exposure to the disaster across numerous studies (Durham *et al.* 1985; Green *et al.* 1990, 1994; Abenhaim *et al.* 1992; Joseph *et al.* 1994; Tyano *et al.* 1996; Cwikel *et al.* 2000; Tucker *et al.* 2000; Sungur & Kaya, 2001; Galea *et al.* 2002; Neria *et al.* 2006c). As we already noted above, the prevalence of PTSD is higher among persons who were directly exposed to the disaster (often referred as the 'victims' of a disaster in disaster studies), lower among rescue workers and first responders, and yet even lower in the general population. These three types of samples studied are likely to represent different levels of severity of disaster exposure, with direct victims having the highest exposure and associated PTSD prevalence and people in the general population having the lowest levels of exposure and PTSD prevalence. Studies that focused on several groups, with different levels of exposure enabled direct comparisons between people with different levels of disaster exposure. For example, studies that assessed areas close and distant from a disaster site have repeatedly showed that the prevalence of PTSD is higher among persons closer to the disaster than among those who are in distant areas (Havenaar *et al.* 1997; Schlenger *et al.* 2002; Jordan *et al.* 2004; Neria *et al.* 2006c).

Disasters frequently involve populations which are not directly exposed to the trauma such as people who experience loss of family members or friends or colleagues, or those who suffered property loss, were forced to relocate, or were exposed to the event through the media. This raises two critical points about the burden and the nature of post-disaster psychopathology. First, the mental health consequences of such events among those indirectly exposed to a disaster may well exceed the mental health consequences among those who were directly exposed or close to the disaster epicenter. Although, as we note in this review, there is little question that there is a dose–response relationship between the extent of trauma and the mental health burden of disasters, this relation may not necessarily mean that the principal population mental health burden of a disaster is among those who were most directly affected by the disaster (Galea *et al.* 2005). Second, the extant post-disaster literature provides an opportunity to assess the relation between indirect exposure to a trauma and risk of PTSD. The literature reviewed here is mixed on this latter point. For example, while Neria and colleagues, in their study of primary-care patients exposed to the 9/11 terrorist attacks in Northern Manhattan, found that indirect exposure to the attacks on the World Trade Center was not associated with risk of PTSD (Neria *et al.* 2006b), other studies conducted in national samples after the same attacks (Schlenger *et al.* 2002; Silver *et al.* 2002) and in distant areas after the Oklahoma City bombing (Pfefferbaum *et al.* 1999) provide evidence for a probable relation between indirect exposure and PTSD. These findings may challenge one of the core criteria of PTSD according to DSM-IV (Criteria A). Most of the persons interviewed in post-9/11 national surveys reported an indirect exposure to the attacks, mostly through TV broadcasts. The inclusion of this type of exposure is certainly new to the discipline of trauma research and deserves further attention (Ahern *et al.*

2002). The events of 9/11 and the recent terrorist attacks in Europe and Asia, as well as recent major natural disasters, all provide an opportunity to examine whether direct exposure to trauma is a necessary condition for PTSD, or whether alternatively, an interaction between a 'sufficient' level of exposure (even indirect), and certain risk factors (e.g. genetic susceptibility) can result in true post-exposure psychopathology.

Burden of PTSD in the aftermath of disasters—A large body of research conducted after disasters in the past three decades suggests that the burden of PTSD among persons who were exposed to disasters is significant. The post-disaster PTSD literature suggests that there are fairly consistent estimates of PTSD that can be expected in the first year after exposure among specific risk groups. Specifically, the prevalence of PTSD among direct victims of disasters ranges between 30% and 40%; the range of PTSD prevalence among rescue workers is lower, ranging between 10% and 20%, while the range of PTSD rates in the general population is the lowest and expected to be between 5% and 10%. The most consistently documented determinants of the risk of PTSD across studies are measures of the magnitude of the exposure to the event. Particularly, degree of physical injury, immediate risk of life, severity of property destruction and frequency of fatalities are especially predictive of high rates of PTSD. Therefore, across samples and studies, survivors and direct victims of a disaster are consistently shown to have increased risk of PTSD than persons in the general population, regardless of the national or political consequences of a particular disaster. Aside from the observation of the centrality of trauma exposure as a determinant of PTSD, as previously noted (Galea *et al.* 2005), many post-disaster studies vary considerably in the range of correlates tested and the model-building techniques used to assess statistically significant correlates, suggesting the need for caution when drawing inferences about associations of PTSD with correlates in post-disaster research. For example, while it is generally true to suggest that direct victims or females are at higher risk for PTSD in the wake of disasters, it is sometimes unclear whether the lack of significant associations between proximity of exposure and PTSD, or gender and PTSD are due to specific disaster type and its consequences or the mediating role of other variables (e.g. relationship with deceased, social support) which obscure the exposure–PTSD and gender–PTSD associations in multivariate analyses.

Most of the studies in the wake of disasters have used cross-sectional designs. The relatively small body of research on the course of PTSD over time is complicated by major methodological limitations. Variability in sample types, sample sizes, point of times of assessments, screening or diagnostic instruments, reduction is sample size over time, are only some of the differences noted between studies assessed here, limiting comparability and the drawing of definitive inference about the course of PTSD.

Limitations

The aim of the current review was to build on and update previous work and to systematically review up-to-date evidence regarding post-disaster PTSD. Several decisions made in the conduct of this review need to be borne in mind when interpreting the results we present here. First, we opted to include a wide range of PTSD studies, with notable differences in sampling and measurements methods. Consequently, we included studies with

different levels of research quality. Moreover, the studies reviewed here come from different disciplines and frequently present results quite differently, limiting our capacity to employ uniform principles of study inclusion. Second, there may be cross-cultural factors that limit the validity of instruments applied in different countries when these instruments were primarily designed to assess psychopathology in developed countries, or majority populations. This suggests caution in interpreting data from studies across countries. Third, this review summarizes the published English-language peer-reviewed literature. Hence, we do not here provide information about PTSD across the entire universe of disasters that do happen worldwide. There is likely a substantial imbalance between studies that are carried out and where disasters do actually occur. Cross-cultural differences between rich and poor countries may mean that the epidemiology of PTSD in less rich countries may be different than that documented here, arising from the available literature. Fourth, given the complexity of defining traumatic event exposure, as noted above, we are not able, in this review, to systematically shed much light on the conditional probability of PTSD differential on specific traumatic event exposure. Fifth, following previous lines of work (Brewin *et al.* 2000; Galea *et al.* 2005) we decided to include findings of studies which specifically assessed PTSD in the wake of disasters. We did not include studies of depression, complicated grief or substance abuse in the wake of disasters and as such, we may be limiting our appreciation of the centrality of co-morbidity to the burden and trajectory of PTSD after disasters. Similarly, our review did not describe studies which assessed changes in service utilization or mental health treatment-seeking and the relations between such behaviors and PTSD; service utilization and mental health treatment-seeking are of considerable interest to public mental health planners and not including consideration of these subjects may be underrepresenting the social and economic burden of PTSD after disasters. Service utilization and treatment may fruitfully be considered as subjects of study in future work.

Conclusion and implications for future disaster research

Several high-profile disasters during the past three decades, combined with improvements in communication and transportation enabling access to areas where disasters occur, have enabled mental and public health researchers, around the globe, to examine various aspects of the associations between exposure to disasters and PTSD. The evidence suggests that the burden of PTSD among populations exposed to disasters is substantial. Post-disaster PTSD is associated with a range of correlates including sociodemographic and background factors, event exposure characteristics, emotional states, social support factors and personality traits. Relatively small numbers of studies have employed longitudinal assessments enabling documentation of the course of PTSD.

However, the review of the literature reveals that several areas remain underexplored and limit the extent to which the wealth of available data may fruitfully guide intervention. We hope that future research will provide better guidance with regard to at least two key questions. First, the course of PTSD after disasters remains unclear. Our review indicates that in order to provide reliable estimates of course of post-disaster psychopathology and to enable comparisons between studies, substantial progress is needed in all areas of measurement (e.g. instruments and methods of administration), time-frames for follow-ups

and sampling procedures. Notably, a clearer understanding of the trajectory of PTSD and the determinants of this trajectory, including the groups among whom PTSD resolves spontaneously, those among whom it persists in the long-term, and those with more complicated lapsing/relapsing pattern will be invaluable in guiding the implementation of effective intervention strategies. Second, future development of interventions would benefit from work that more explicitly and clearly identifies populations at risk (e.g. minorities, elderly, children, direct victims, first responders). Our review suggests that while it is safe to expect a significant decline in psychopathology in the general population, a number of groups remain highly vulnerable to PTSD in the short-term and may well have a different long-term course of PTSD and bear the brunt of the social and economic consequences associated with this condition. The literature to date has yet to comprehensively discuss what the psychological, cultural, and biological factors might be that shape vulnerability to traumatic events. It is our view that such progress is critical to highlight the needs of high-risk populations, and is necessary for tailoring appropriate interventions to the right people in the wake of disasters.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

APA. Diagnostic and Statistical Manual of Mental Disorders. 3rd. American Psychiatric Association; Washington, DC: 1980. (DSM-III)

Abenhaim L, Dab W, Salmi LR. Study of civilian victims of terrorist attacks (France 1982–1987). Journal of Clinical Epidemiology. 1992; 45:103–109. [PubMed: 1573426]

Adams RE, Boscarino JA. Differences in mental health outcomes among Whites, African Americans, and Hispanics following a community disaster. Psychiatry. 2005; 68:250–265. [PubMed: 16253112]

Ahern J, Galea S, Resnick H, Kilpatrick D, Bucuvalas M, Gold J, Vlahov D. Television images and psychological symptoms after the September 11 terrorist attacks. Psychiatry. 2002; 65:289–300. [PubMed: 12530330]

Alexander DA. Stress among police body handlers. A long-term follow-up. The British Journal of Psychiatry. 1993; 163:806–808. [PubMed: 8306124]

Armagan E, Engindeniz Z, Devay AO, Erdur B, Ozcakir A. Frequency of post-traumatic stress disorder among relief force workers after the tsunami in Asia: do rescuers become victims? Prehospital and Disaster Medicine. 2006; 21:168–172. [PubMed: 16892881]

Basoglu M, Kilic C, Salcioglu E, Livanou M. Prevalence of posttraumatic stress disorder and comorbid depression in earthquake survivors in Turkey: an epidemiological study. Journal of Traumatic Stress. 2004; 17:133–141. [PubMed: 15141786]

Bradburn IS. After the earth shook: children's stress symptoms 6–8 months after a disaster. Advances in Behaviour Research and Therapy. 1991; 13:173–179.

Breslau N, Chase GA, Anthony JC. The uniqueness of the DSM definition of post-traumatic stress disorder: implications for research. Psychological Medicine. 2002; 32:573–576. [PubMed: 12102371]

Breslau N, Davis GC, Andreski P, Peterson E. Traumatic events and posttraumatic stress disorder in an urban population of young adults. Archives of General Psychiatry. 1991; 48:216–222. [PubMed: 1996917]

Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. Archives of General Psychiatry. 1998; 55:626–632. [PubMed: 9672053]

Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. Journal of Consulting and Clinical Psychology. 2000; 68:748–766. [PubMed: 11068961]

Brunello N, Davidson JR, Deahl M, Kessler RC, Mendlewicz J, Racagni G, Shalev AY, Zohar J. Posttraumatic stress disorder: diagnosis and epidemiology, comorbidity and social consequences, biology and treatment. Neuropsychobiology. 2001; 43:150–162. [PubMed: 11287794]

Canino G, Bravo M, Rubio-Stipec M, Woodbury M. The impact of disaster on mental health: prospective and retrospective analyses. International Journal of Mental Health. 1990; 19:51–69.

Carlier IV, Gersons BP. Stress reactions in disaster victims following the Bijlmermeer plane crash. Journal of Traumatic Stress. 1997; 10:329–335. [PubMed: 9136097]

Carr VJ, Lewin TJ, Kenardy JA, Webster RA, Hazell PL, Carter GL, Williamson M. Psychosocial sequelae of the 1989 Newcastle earthquake: III. Role of vulnerability factors in post-disaster morbidity. Psychological Medicine. 1997a; 27:179–190. [PubMed: 9122298]

Carr VJ, Lewin TJ, Webster RA, Hazell PL, Kenardy JA, Carter GL. Psychosocial sequelae of the 1989 Newcastle earthquake: I. Community disaster experiences and psychological morbidity 6 months post-disaster. Psychological Medicine. 1995; 25:539–555. [PubMed: 7480435]

Carr VJ, Lewin TJ, Webster RA, Kenardy JA, Hazell PL, Carter GL. Psychosocial sequelae of the 1989 Newcastle earthquake: II. Exposure and morbidity profiles during the first 2 years post-disaster. Psychological Medicine. 1997b; 27:167–178. [PubMed: 9122297]

CDC. Mental health status of World Trade Center rescue and recovery workers and volunteers – New York City, July 2002–August 2004. Morbidity and Mortality Weekly Reports. 2004; 53:812–815.

CDC. Health hazard evaluation of police officers and firefighters after Hurricane Katrina – New Orleans, Louisiana, October 17–28 and November 30–December 5, 2005. Morbidity and Mortality Weekly Reports. 2006; 55:456–458.

Chang CM, Connor KM, Lai TJ, Lee LC, Davidson JR. Predictors of posttraumatic outcomes following the 1999 Taiwan earthquake. Journal of Nervous and Mental Disease. 2005; 193:40–46. [PubMed: 15674133]

Chang CM, Lee LC, Connor KM, Davidson JR, Jeffries K, Lai TJ. Posttraumatic distress and coping strategies among rescue workers after an earthquake. Journal of Nervous and Mental Disease. 2003; 191:391–398. [PubMed: 12826921]

Chung MC, Dennis I, Easthope Y, Farmer S, Werrett J. Differentiating posttraumatic stress between elderly and younger residents. Psychiatry. 2005; 68:164–713. [PubMed: 16247859]

Cwikel JG, Abdelgani A, Rozovski U, Kordysh E, Goldsmith JR, Quastel MR. Long-term stress reactions in new immigrants to Israel exposed to the Chernobyl accident. Anxiety Stress and Coping. 2000; 13:413–439.

Durham TW, McCammon SL, Allison EJ Jr. The psychological impact of disaster on rescue personnel. Annals of Emergency Medicine. 1985; 14:664–668. [PubMed: 4014815]

Durkin ME. Major depression and post-traumatic stress disorder following the Coalinga and Chile earthquakes: a cross-cultural comparison. Journal of Social and Behavior Personality. 1993; 8:405–420.

Favaro A, Zaetta C, Colombo G, Santonastaso P. Surviving the Vajont disaster: psychiatric consequences 36 years later. Journal of Nervous and Mental Disease. 2004; 192:227–231. [PubMed: 15091304]

Finnsdottir T, Elklit A. Posttraumatic sequelae in a community hit by an avalanche. Journal of Traumatic Stress. 2002; 15:479–485. [PubMed: 12482187]

Franklin CL, Young D, Zimmerman M. Psychiatric patients' vulnerability in the wake of the September 11th terrorist attacks. Journal of Nervous and Mental Disease. 2002; 190:833–838. [PubMed: 12486371]

Freed D, Bowler R, Fleming I. Post-traumatic stress disorder as a consequence of a toxic spill in Northern California. Journal of Applied Social Psychology. 1998; 28:264–281.

Fullerton CS, Ursano RJ, Reeves J, Shigemura J, Grieger T. Perceived safety in disaster workers following 9/11. Journal of Nervous and Mental Disease. 2006; 194:61–63. [PubMed: 16462558]

Galea S, Ahern J, Resnick H, Kilpatrick D, Bucuvalas M, Gold J, Vlahov D. Psychological sequelae of the September 11 terrorist attacks in New York City. New England Journal of Medicine. 2002; 346:982–987. [PubMed: 11919308]

Galea S, Nandi A, Vlahov D. The epidemiology of post-traumatic stress disorder after disasters. Epidemiologic Reviews. 2005; 27:78–91. [PubMed: 15958429]

Galea S, Resnick H. Posttraumatic stress disorder in the general population after mass terrorist incidents: considerations about the nature of exposure. CNS Spectrums. 2005; 10:107–115. [PubMed: 15685121]

Galea S, Vlahov D, Resnick H, Ahern J, Susser E, Gold J, Bucuvalas M, Kilpatrick D. Trends of probable post-traumatic stress disorder in New York City after the September 11 terrorist attacks. American Journal of Epidemiology. 2003; 158:514–524. [PubMed: 12965877]

Galea S, Vlahov D, Tracy M, Hoover DR, Resnick H, Kilpatrick D. Hispanic ethnicity and post-traumatic stress disorder after a disaster: evidence from a general population survey after September 11, 2001. Annals of Epidemiology. 2004; 14:520–531. [PubMed: 15350950]

Godeau E, Vignes C, Navarro F, Iachan R, Ross J, Pasquier C, Guinard A. Effects of a large-scale industrial disaster on rates of symptoms consistent with posttraumatic stress disorders among schoolchildren in Toulouse. Archives of Pediatrics and Adolescent Medicine. 2005; 159:579–584. [PubMed: 15939859]

Goenjian AK, Pynoos RS, Steinberg AM, Najarian LM, Asarnow JR, Karayan I, Ghurabi M, Fairbanks LA. Psychiatric comorbidity in children after the 1988 earthquake in Armenia. Journal of the American Academy of Child and Adolescent Psychiatry. 1995; 34:1174–1184. [PubMed: 7559312]

Goenjian AK, Steinberg AM, Najarian LM, Fairbanks LA, Tashjian M, Pynoos RS. Prospective study of posttraumatic stress, anxiety, and depressive reactions after earthquake and political violence. American Journal of Psychiatry. 2000; 157:911–916. [PubMed: 10831470]

Green BL, Grace MC, Vary MG, Kramer TL, Gleser GC, Leonard AC. Children of disaster in the second decade: a 17-year follow-up of Buffalo Creek survivors. Journal of the American Academy of Child and Adolescent Psychiatry. 1994; 33:71–79. [PubMed: 8138524]

Green BL, Lindy JD, Grace MC, Gleser GC, Leonard AC, Korol M, Winget C. Buffalo Creek survivors in the second decade: stability of stress symptoms. American Journal of Orthopsychiatry. 1990; 60:43–54. [PubMed: 2305844]

Hanson RF, Kilpatrick DG, Freedy JR, Saunders BE. Los Angeles County after the 1992 civil disturbances: degree of exposure and impact on mental health. Journal of Consulting and Clinical Psychology. 1995; 63:987–996. [PubMed: 8543721]

Havenaar JM, Rumyantzeva GM, van den Brink W, Poelijoe NW, van den Bout J, van Engeland H, Koeter MW. Long-term mental health effects of the Chernobyl disaster: an epidemiologic survey in two former Soviet regions. American Journal of Psychiatry. 1997; 154:1605–1607. [PubMed: 9356574]

Hoven CW, Duarte CS, Lucas CP, Wu P, Mandell DJ, Goodwin RD, Cohen M, Balaban V, Woodruff BA, Bin F, Musa GJ, Mei L, Cantor PA, Aber JL, Cohen P, Susser E. Psychopathology among New York city public school children 6 months after September 11. Archives of General Psychiatry. 2005; 62:545–552. [PubMed: 15867108]

Hull AM, Alexander DA, Klein S. Survivors of the Piper Alpha oil platform disaster: long-term follow-up study. British Journal of Psychiatry. 2002; 181:433–438. [PubMed: 12411271]

Jordan NN, Hoge CW, Tobler SK, Wells J, Dydek GJ, Egerton WE. Mental health impact of 9/11 Pentagon attack: validation of a rapid assessment tool. American Journal of Preventive Medicine. 2004; 26:284–293. [PubMed: 15110054]

Joseph S, Yule W, Williams R, Hodgkinson P. Correlates of post-traumatic stress at 30 months: the Herald of Free Enterprise disaster. Behaviour Research and Therapy. 1994; 32:521–524. [PubMed: 8042963]

Kessler RC. Posttraumatic stress disorder: the burden to the individual and to society. Journal of Clinical Psychiatry. 2000; 61(Suppl 5):4–12. discussion 13–14. [PubMed: 10761674]

Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. Archives of General Psychiatry. 1995; 52:1048–1060. [PubMed: 7492257]

Koplewicz HS, Vogel JM, Solanto MV, Morrissey RF, Alonso CM, Abikoff H, Gallagher R, Novick RM. Child and parent response to the 1993 World Trade Center bombing. Journal of Traumatic Stress. 2002; 15:77–85. [PubMed: 11936725]

Lee I, Ha YS, Kim YA, Kwon YH. PTSD symptoms in elementary school children after Typhoon Rusa. Taehan Kanho Hakhoe Chi. 2004; 34:636–645. [PubMed: 15502429]

Liu A, Tan H, Zhou J, Li S, Yang T, Wang J, Liu J, Tang X, Sun Z, Wen SW. An epidemiologic study of posttraumatic stress disorder in flood victims in Hunan China. Canadian Journal of Psychiatry. 2006; 51:350–354. [PubMed: 16786815]

Livanou M, Basoglu M, Salcioglu E, Kalendar D. Traumatic stress responses in treatment-seeking earthquake survivors in Turkey. Journal of Nervous and Mental Disease. 2002; 190:816–823. [PubMed: 12486369]

Madakasira S, O'Brien KF. Acute posttraumatic stress disorder in victims of a natural disaster. Journal of Nervous and Mental Disease. 1987; 175:286–290. [PubMed: 3572380]

McFarlane AC. The longitudinal course of posttraumatic morbidity. The range of outcomes and their predictors. Journal of Nervous and Mental Disease. 1988; 176:30–39. [PubMed: 3335835]

McFarlane AC, Papay P. Multiple diagnoses in posttraumatic stress disorder in the victims of a natural disaster. Journal of Nervous and Mental Disease. 1992; 180:498–504. [PubMed: 1500931]

Miguel-Tobal JJ, Cano-Vindel A, Gonzalez-Ordi H, Iruarrizaga I, Rudenstine S, Vlahov D, Galea S. PTSD and depression after the Madrid March 11 train bombings. Journal of Traumatic Stress. 2006; 19:69–80. [PubMed: 16568454]

Mileti, D. Disasters by Design. Joseph Henry Press; Washington, DC: 1999.

Mirzamani M, Bolton D. PTSD symptoms of mothers following occurrence of a disaster affecting their children. Psychol Rep. 2002; 90:431–438. [PubMed: 12061580]

Murphy RT, Wismar K, Freeman K. Stress symptoms among African-American college students after the September 11, 2001 terrorist attacks. Journal of Nervous and Mental Disease. 2003; 191:108–114. [PubMed: 12586964]

Najarian LM, Goenjian AK, Pelcovitz D, Mandel F, Najarian B. The effect of relocation after a natural disaster. Journal of Traumatic Stress. 2001; 14:511–526. [PubMed: 11534882]

Nandi A, Galea S, Ahern J, Vlahov D. Probable cigarette dependence, PTSD, and depression after an urban disaster: results from a population survey of New York City residents 4 months after September 11, 2001. Psychiatry. 2005; 68:299–310. [PubMed: 16599397]

Neria Y, Gross R, Litz B, Maguen S, Insel B, Seirmarco G, Rosenfeld H, Suh EJ, Kishon R, Cook JM, Marshall RD. Prevalence and psychological correlates of complicated grief among bereaved adults. Journal of Traumatic Stress. 2007; 20:251–262. [PubMed: 17597124]

Neria, Y.; Gross, R.; Marshall, R., editors. 9/11: Mental Health in the Wake of Terrorist Attacks. Cambridge University Press; New York: 2006a.

Neria, Y.; Gross, R.; Marshall, R. Mental health in the wake of terrorism: making sense of mass casualty trauma. In: Neria, Y.; Gross, R.; Marshall, R., editors. 9/11: Mental Health in the Wake of Terrorist Attacks. Cambridge University Press; New York: 2006b.

Neria Y, Gross R, Olfson M, Gameroff MJ, Wickramaratne P, Das A, Pilowsky D, Feder A, Blanco C, Marshall RD, Lantigua R, Shea S, Weissman MM. Posttraumatic stress disorder in primary care one year after the 9/11 attacks. General Hospital Psychiatry. 2006c; 28:213–222. [PubMed: 16675364]

Neuner F, Schauer E, Catani C, Ruf M, Elbert T. Post-tsunami stress: a study of posttraumatic stress disorder in children living in three severely affected regions in Sri Lanka. Journal of Traumatic Stress. 2006; 19:339–347. [PubMed: 16789000]

Norris FH. Epidemiology of trauma: frequency and impact of different potentially traumatic events on different demographic groups. Journal of Consulting and Clinical Psychology. 1992; 60:409–418. [PubMed: 1619095]

Norris FH, Friedman MJ, Watson PJ, Byrne CM, Diaz E, Kaniasty K. 60,000 disaster victims speak: Part I. An empirical review of the empirical literature, 1981–2001. Psychiatry. 2002; 65:207–239. [PubMed: 12405079]

Norris FH, Murphy AD, Baker CK, Perilla JL. Postdisaster PTSD over four waves of a panel study of Mexico's 1999 flood. Journal of Traumatic Stress. 2004; 17:283–292. [PubMed: 15462535]

Norris FH, Perilla JL, Riad JK, Kaniasty K, Lavizzo EA. Stability and change in stress, resources, and psychological distress following natural disaster: findings from Hurricane Andrew. Anxiety Stress Coping. 1999; 12:363–396. [PubMed: 21777067]

North CS, Pfefferbaum B, Narayanan P, Thielman S, McCoy G, Dumont C, Kawasaki A, Ryosho N, Kim YS, Spitznagel EL. Comparison of post-disaster psychiatric disorders after terrorist bombings in Nairobi and Oklahoma City. British Journal of Psychiatry. 2005; 186:487–493. [PubMed: 15928359]

North CS, Smith EM, Spitznagel EL. Posttraumatic stress disorder in survivors of a mass shooting. American Journal of Psychiatry. 1994; 151:82–88. [PubMed: 8267140]

North CS, Smith EM, Spitznagel EL. One-year follow-up of survivors of a mass shooting. American Journal of Psychiatry. 1997; 154:1696–1702. [PubMed: 9396948]

Onder E, Tural U, Aker T, Kilic C, Erdogan S. Prevalence of psychiatric disorders three years after the 1999 earthquake in Turkey: Marmara Earthquake Survey (MES). Social Psychiatry and Psychiatric Epidemiology. 2006; 41:868–874. [PubMed: 16906439]

Ozen S, Sir A. Frequency of PTSD in a group of search and rescue workers two months after 2003 Bingol (Turkey) earthquake. Journal of Nervous and Mental Disease. 2004; 192:573–575. [PubMed: 15387162]

Palinkas LA, Petterson JS, Russell J, Downs MA. Community patterns of psychiatric disorders after the Exxon Valdez oil spill. American Journal of Psychiatry. 1993; 150:1517–1523. [PubMed: 8379557]

Parslow RA, Jorm AF, Christensen H. Associations of pre-trauma attributes and trauma exposure with screening positive for PTSD: analysis of a community-based study of 2,085 young adults. Psychological Medicine. 2006; 36:387–395. [PubMed: 16255836]

Pfefferbaum B, Nixon SJ, Krug RS, Tivis RD, Moore VL, Brown JM, Pynoos RS, Foy D, Gurwitch RH. Clinical needs assessment of middle and high school students following the 1995 Oklahoma City bombing. American Journal of Psychiatry. 1999; 156:1069–1074. [PubMed: 10401454]

Pynoos RS, Frederick C, Nader K, Arroyo W, Steinberg A, Eth S, Nunez F, Fairbanks L. Life threat and posttraumatic stress in school-age children. Archives of General Psychiatry. 1987; 44:1057–1063. [PubMed: 3689093]

Quarantelli EL. What is a disaster? Six views of the problem. International Journal of Emergency Mental Health. 1995; 13:221–229.

Quarantelli, EL., editor. What is a Disaster: Perspectives on the Question. Routledge; London, New York: 1998.

Resnick HS, Kilpatrick DG, Dansky BS, Saunders BE, Best CL. Prevalence of civilian trauma and posttraumatic stress disorder in a representative national sample of women. Journal of Consulting and Clinical Psychology. 1993; 61:984–991. [PubMed: 8113499]

Russoniello CV, Skalko TK, O'Brien K, McGhee SA, Bingham-Alexander D, Beatley J. Childhood posttraumatic stress disorder and efforts to cope after Hurricane Floyd. Behavioral Medicine. 2002; 28:61–71. [PubMed: 12613287]

Schlenger WE, Caddell JM, Ebert L, Jordan BK, Rourke KM, Wilson D, Thalji L, Dennis JM, Fairbank JA, Kulka RA. Psychological reactions to terrorist attacks: findings from the National Study of Americans' Reactions to September 11. Journal of the American Medical Asssociation. 2002; 288:581–588.

Scott RB, Brooks N, McKinlay W. Post-traumatic morbidity in a civilian community of litigants: a follow-up at 3 years. Journal of Traumatic Stress. 1995; 8:403–417. [PubMed: 7582606]

Shannon MP, Lonigan CJ, Finch AJ Jr, Taylor CM. Children exposed to disaster: I. Epidemiology of post-traumatic symptoms and symptom profiles. Journal of the American Academy of Child and Adolescent Psychiatry. 1994; 33:80–93. [PubMed: 8138525]

Silver RC, Holman EA, McIntosh DN, Poulin M, Gil-Rivas V. Nationwide longitudinal study of psychological responses to September 11. Jama. 2002; 288:1235–1244. [PubMed: 12215130]

Sims A, Sims D. The phenomenology of post-traumatic stress disorder. A symptomatic study of 70 victims of psychological trauma. Psychopathology. 1998; 31:96–112. [PubMed: 9561553]

Sloan P. Post-traumatic stress in survivors of an airplane crash-landing: a clinical and explanatory research intervention. Journal of Traumatic Stress. 1988; 1:211–229.

Smith EM, North CS, Spitznagel EL. Post-traumatic stress in survivors of three disasters. Journal of Social Behavior and Personality. 1993; 8:353–368.

Soldatos CR, Paparrigopoulos TJ, Pappa DA, Christodoulou GN. Early post-traumatic stress disorder in relation to acute stress reaction: an ICD-10 study among help seekers following an earthquake. Psychiatry Research. 2006; 143:245–253. [PubMed: 16872683]

Spurrell MT, McFarlane AC. Post-traumatic stress disorder and coping after a natural disaster. Social Psychiatry and Psychiatric Epidemiology. 1993; 28:194–200. [PubMed: 8235807]

Stuber J, Resnick H, Galea S. Gender disparities in posttraumatic stress disorder after mass trauma. Gender Medicine. 2006; 3:54–67. [PubMed: 16638601]

Sungur M, Kaya B. The onset and longitudinal course of a man-made post-traumatic morbidity: survivors of the Sivas disaster. International Journal of Psychiatry in Clinical Practice. 2001; 5:195–202. [PubMed: 24926753]

Thompson MP, Norris FH, Hanacek B. Age differences in the psychological consequences of Hurricane Hugo. Psychology and Aging. 1993; 8:606–616. [PubMed: 8292289]

Tierny, K.; Lindell, M.; Perry, R. Facing the Unexpected Disaster: Preparedness and Response in the United States. Joseph Henry Press; Washington, DC: 2001.

Tucker P, Pfefferbaum B, Nixon SJ, Dickson W. Predictors of post-traumatic stress symptoms in Oklahoma City: exposure, social support, peri-traumatic responses. Journal of Behavioral Health Services and Research. 2000; 27:406–416. [PubMed: 11070634]

Tyano S, Iancu I, Solomon Z, Sever J, Goldstein I, Touviana Y, Bleich A. Seven-year follow-up of child survivors of a bus-train collision. Journal of the American Academy of Child and Adolescent Psychiatry. 1996; 35:365–373. [PubMed: 8714326]

Ursano RJ, Fullerton CS, Kao TC, Bhartiya VR. Longitudinal assessment of posttraumatic stress disorder and depression after exposure to traumatic death. Journal of Nervous and Mental Disease. 1995; 183:36–42. [PubMed: 7807068]

van Griensven F, Chakkraband ML, Thienkrua W, Pengjuntr W, Lopes Cardozo B, Tantipiwatanaskul P, Mock PA, Ekassawin S, Varangrat A, Gotway C, Sabin M, Tappero JW. Mental health problems among adults in tsunami-affected areas in southern Thailand. Journal of the American Medical Association. 2006; 296:537–548. [PubMed: 16882960]

Verger P, Dab W, Lamping DL, Loze JY, Deschaseaux-Voinet C, Abenhaim L, Rouillon F. The psychological impact of terrorism: an epidemiologic study of posttraumatic stress disorder and associated factors in victims of the 1995–1996 bombings in France. American Journal of Psychiatry. 2004; 161:1384–1389. [PubMed: 15285963]

Vernberg EM, Silverman WK, La Greca AM, Prinstein MJ. Prediction of posttraumatic stress symptoms in children after hurricane Andrew. Journal of Abnormal Psychology. 1996; 105:237–248. [PubMed: 8723005]

Wang X, Gao L, Shinfuku N, Zhang H, Zhao C, Shen Y. Longitudinal study of earthquake-related PTSD in a randomly selected community sample in north China. American Journal of Psychiatry. 2000; 157:1260–1266. [PubMed: 10910788]

Table 1

Summary of key studies assessing post-traumatic stress after human-made disasters

Study	Sample type	Sample size (*n*)	Prevalence					
			T1[a]	%	T2	%	T3	%
1992 Los Angeles County civil disturbances (29 April 1992)								
Hanson *et al.* (1995)[b]	Community	*n*=1200 in LA County	6–8 months	4.1%				
2001 Terrorist attacks, New York City and Washington, DC (11 September 2001)								
Galea *et al.* (2002)[b]	Community	*n*=988 in Manhattan	5–8 weeks	7.5%				
Schlenger *et al.* (2002)[b]	Community	*n*=2273 nationally	1–2 months	11.2% in NYC, 4.3% nationally				
Nandi *et al.* (2005)[b]	Community	*n*=2001 in NYC	4 months	7.4%				
Hoven *et al.* (2005)[b]	Community	*n*=8236 NYC students	6 months	10.6%				
Galea *et al.* (2004)[b]	Community	*n*=2616 in NYC metropolitan area	6–9 months	5.2% (non-Hispanics), 14.3% (Dominicans), 13.2% (Puerto Ricans), 6.1% (other Hispanics)				
Stuber *et al.* (2006)[b]	Community	*n*=2752 in NYC metropolitan area	6–9 months	6.5% (women), 5.4% (men)				
Silver *et al.* (2002)[c]	Community	*n*=933 nationally at 2 months, 787 nationally at 6 months	2 months	17.0%	6 months	5.8%		
Galea *et al.* (2003)[d]	Community	*n*=988 in Manhattan at 1 month, 2001 in NYC at 4 months, 1570 in NYC at 6 months	1 month	7.5%	4 months	1.7%	6 months	0.6%
Adams & Boscarino (2005)[b]	Community	*n*=2368 in NYC	1 year	4% (Whites), 5.5% (African Americans), 5.3% (Dominicans), 8.4% (Puerto Ricans), 5% (other Latinos)				
Neria *et al.* (2006c)[b]	Mixed	*n*=930 NYC primary care patients	7–16 months	10.2%				
Miguel-Tobal *et al.* (2006)[b]	Community	*n*=1589 in Madrid	1–3 months	2.3%				

[a] Timing of assessment(s) after the disaster.

[b] Cross-sectional study design.

[c] Prospective cohort study design.

[d] Serial cross-sectional study design.

Table 2

Summary of key studies assessing post-traumatic stress after technological disasters

			Prevalence	
Study	**Sample type**	**Sample size (*n*)**	**T1[a]**	**%**
1986 Chernobyl nuclear reactor accident, Ukraine (26 April 1986)				
Havenaar *et al.* (1997)[b]	Community	*n*=1617 from Gomel (near accident) and *n*=1427 from Tver (far from accident)	6.5 years	2.4% in Gomel, 0.4% in Tver
1989 Exxon Valdez oil spill, Alaska (24 March 1989)				
Palinkas *et al.* (1993)[b]	Community	*n*=593 from variably affected communities	1 year	9.4%
2001 Chemical factory explosion, Toulouse, France (21 September 2001)				
Godeau *et al.* (2005)[b]	Community	*n*=1477 students from directly and indirectly exposed communities	9 months	44.6% (directly exposed 11- to 13-year-olds), 28.5% (directly exposed 15- to 17-year-olds), 22.1% (indirectly exposed 11- to 13-year-olds), 4.4% (indirectly exposed 15- to 17-year-olds)

[a] Timing of assessment(s) after the disaster.

[b] Cross-sectional study design.

Table 3

Summary of key studies assessing post-traumatic stress after natural disasters

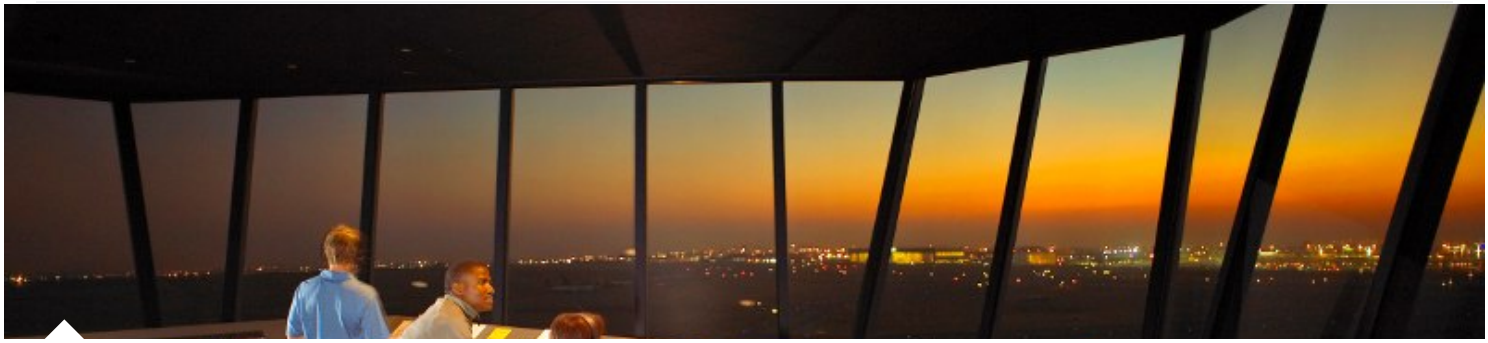
			Prevalence			
Study	**Sample type**	**Sample size (*n*)**	**T1[a]**	**%**	**T2**	**%**
1989 Newcastle earthquake, Newcastle, Australia (28 December 1989)						
Carr *et al.* (1995)[b]	Community	*n*=3007 in Newcastle	6 months	18.3% among highly exposed		
Carr *et al.* (1997b)[c]	Community	*n*=845 in Newcastle	6 months	11% (low exposure), 19% (disruption), 23% (threat), 40 % (disruption and threat)	2 years	3% (low exposure), 8% (disruption), 13% (threat), 19% (disruption and threat)
1998–1999 Floods, Hunan Province, China (1998–1999)						
Liu *et al.* (2006)[b]	Community	*n*=33 340	Within 2.5 years	8.6%		
1999 Turkey earthquakes, Marmara region, Turkey (17 August 1999 and 12 November 1999)						
Basoglu *et al.* (2004)[b]	Community	*n*=530 near epicenter, 420 from 100km away	14 months	23% (near epicenter), 14%(100km away)		
Onder *et al.* (2006)[b]	Community	*n*=683 near epicenter	36 months	19.2% (36 month prevalence), 11.7% (current)		
1999 Mexican floods and mudslides, Mexico (October 1999)						
Norris *et al.* (2004)[c]	Community	*n*=561 from two affected communities	6 months	24%		
2003 Wildfire disaster, Australia, 18 January 2003						
Parslow *et al.* (2006)[c]	Community	*n*=2085	3–18 months	5%		
2004 Earthquake and tsunami, Asia (26 December 2004)						
van Griensven *et al.* (2006)[c]	Community	*n*=371 displaced and 690 non-displaced from Phang Nga, Krabi, and Phuket provinces of Southern Thailand	2 months	11.9% (displaced in Phang Nga), 6.8% (non-displaced in Phang Nga), 3.0% (non-displaced in Krabi and Phuket)	9 months	7.0% (displaced in Phang Nga), 2.3% (non-displaced in Phang Nga)

[a] Timing of assessment(s) after the disaster.

[b] Cross-sectional study design.

[c] Prospective cohort study design

EXHIBIT 66

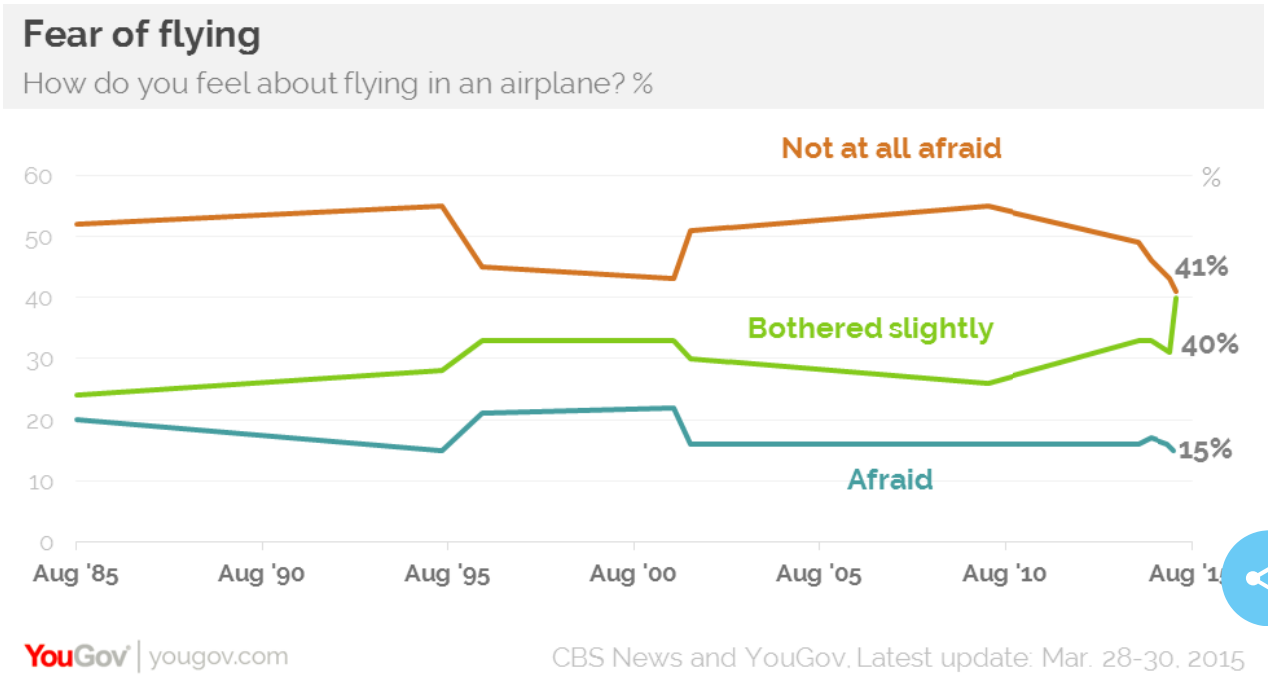


Most Americans now worried about flying

Kathy Frankovic
April 01, 2015, 11:11 AM GMT-4

Just over half of Americans now say that they are at least bothered by flying

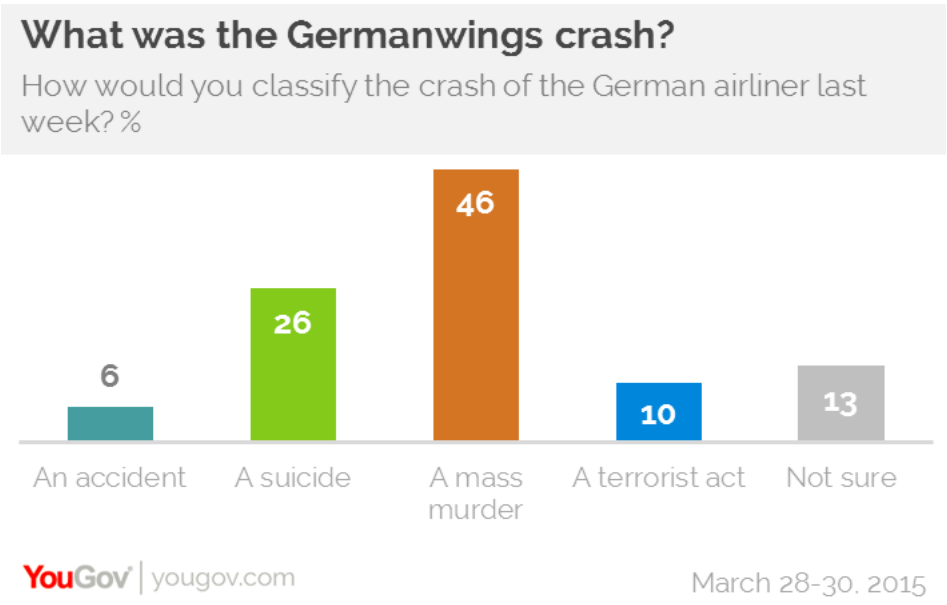
Polls almost never ask questions about flying except after air disasters, and so there is no real trend on how Americans view flying. In the aftermath of the September 11, 2001 terrorist acts, fears of flying rose, but since then only half (and often even fewer) of Americans have expressed even slight concerns about flying.



deliberately crashing the plane into the Alps, also bothered the public. Those saying they are "not at all afraid" of flying is lower than ever in *Economist*/YouGov Polls, and just as low, if not lower, than in the week's following 9/11. More than half are troubled; and while fewer admit they are afraid of flying now than after 9/11, more admit flying bothers them slightly.

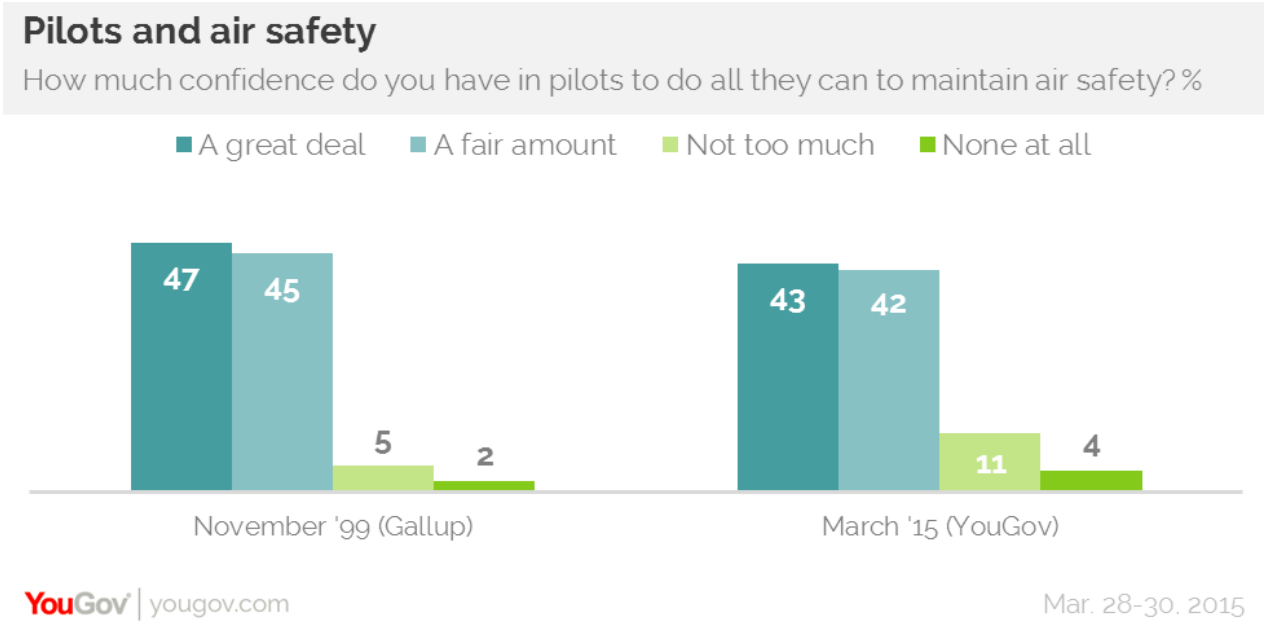
The only other time in this series of polls (which includes the same question asked in CBS News Polls) when a majority expressed concern about flying was in 1996, after the crash of TWA 800 off Long Island. In the weeks following that crash, there was speculation that the plane, which exploded in the air, was brought down by a terrorist attack. The Transportation Safety Board later determined the cause was a fuel tank explosion.

The 9/11 attacks were deliberate acts by those flying the plane. At first, the 1996 TWA crash was thought to be the same. And both of those events took place in the United States, making them very real for Americans. The GermanWings crash, though it happened in France, is also being described as a deliberate act, and the vast majority of Americans not only agree, more than half say it was criminal. Only 6% think it was an accident.

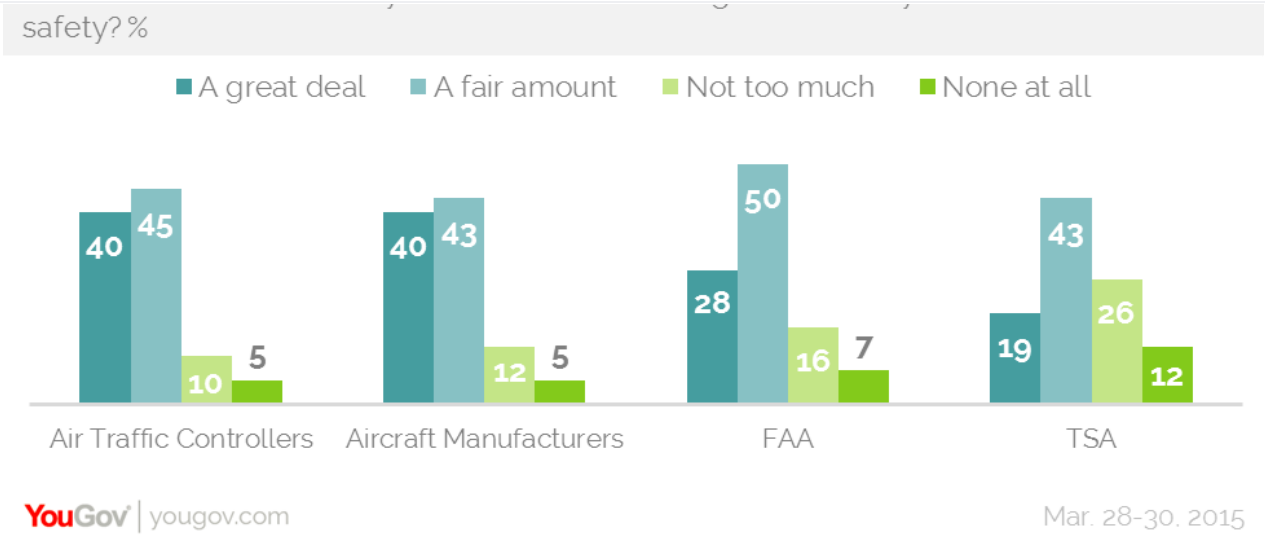


There are significant gender differences in the response to the crash. Women are far more likely than men to express concerns about flying. Nearly two in three

Still, Americans remain fairly confident that airline pilots in general maintain air safety -- nearly as confident as they said they were when Gallup asked the same question 16 years ago. The percentage having not much or no confidence is twice as high as it was in 1999, but 85% continue to have a great deal or at least a fair amount of confidence in in pilot safety.



There are similarly high levels of confidence when it comes to airplane manufacturers and air traffic controllers. There is somewhat lower confidence in government agencies involved in air safety, particularly the Transportation Security Administration – the TSA. Some of that is political. One in four Republicans have little or no confidence in the Federal Aviation Administration (the FAA), and 40% little or no confidence in the TSA.



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Federal Aviation Administration **Flying** **The Economist / YouGov polls**

What issues do you want President Biden to focus on?

POLITICS

The Transportation Security Administration said that the agency considers peanut butter to be a liquid, meaning that if someone takes peanut...

24 days ago

EXHIBIT 67

DOI: 10.1111/1745-9133.12478

CRIMINOLOGY & Public Policy

SPECIAL ISSUE ARTICLE

COUNTERING MASS VIOLENCE IN THE UNITED STATES

Patterns and prevalence of lethal mass violence

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Research Summary: Mass shootings have been identified as a novel American crime problem. The term is merely a new name, however, for an older crime problem—mass murder. The social construction of the mass shooting and mass murder problems have both been driven by "mass public shootings"—incidents that occur in the absence of other criminal activity (e.g., robberies, drug deals, and gang "turf wars") in which a gun was used to kill four or more victims at a public location within a 24-hour period. Using data on 845 mass shootings, including 158 mass public shootings, which occurred in the United States between 1976 and 2018, in this study, I analyze trends in their prevalence and severity (i.e., number of victims killed and wounded). After controlling for growth in the U.S. population, the results show the late 1980s and early 1990s had the highest incidence of mass shootings. Both the incidence and severity of mass public shootings, on the other hand, have increased over the last decade. I also describe the patterns of mass public shootings by reporting incident and offender characteristics.

Policy Implications: Despite the recent growth in mass public shootings, the infrequency with which they occur makes it very challenging to develop broad measures that will reduce their incidence or severity. It may therefore be more effective to focus on strategies that that have shown promise in decreasing violence in general.

KEYWORDS

lethal mass violence, mass murder, mass public shootings

During the late 1980s and early 1990s, a string of high-profile public shootings led to claims that *mass murder* was on the rise and had become "commonplace" in the United States (Duwe, 2007). More recently, the occurrence of massacres in places such as Newtown, Connecticut; Orlando, Florida; and Las Vegas, Nevada, have prompted assertions that *mass shootings* have grown more prevalent and are now "routine" (Cohen, Azrael, & Miller, 2014; Korte, 2016). Yet, the emergence of the mass murder and mass shooting problems have both been fueled by *mass public shootings*, which are incidents in which multiple victims are gunned down in a public place for no apparent rhyme or reason (Duwe, 2018).

In part as a result of the surplus of terms that have been used to describe mass violence, there has been, as Fox and Levin (2015) have pointed out, "mass confusion" over the phrase "mass shooting". It is therefore important, at the outset, to clarify the meaning of terms such as "mass murder", "mass shooting", or "mass public shooting". A mass murder has been defined as an incident in which four or more victims are killed—with any type of weapon—within a 24-hour period (Duwe, 2007; Fox & Levin, 2011). A mass shooting, as defined here, is a mass murder carried out with a firearm. Therefore, a mass shooting is any gun-related mass murder regardless of whether it occurred in a residential setting or a public location. A mass shooting would thus include incidents such as the 1890 Wounded Knee Massacre, the 1929 St. Valentine's Day Massacre, and the recent mass murders in Orlando and Las Vegas.

A mass public shooting, meanwhile, is a gun-related mass murder that takes place at a public location in the absence of other criminal activity (e.g., robberies, drug deals, and gang "turf wars"), military conflict, or collective violence. Although the Las Vegas massacre would qualify as a mass public shooting, the Wounded Knee and St. Valentine's Day massacres would not. Mass public shootings can thus be seen not only as a type of mass murder but also as a specific type of mass shooting.

In this study, I describe the patterns and prevalence of mass violence and, in particular, gun-related mass killings. In doing so, I address not only whether mass shootings have been on the rise but also the profile of those who commit this type of violence. In the next section, I begin by discussing how mass murder and, more recently, mass shootings have been socially constructed as crime problems. Next, given recent concerns over whether mass shootings have increased, I begin by delineating trends in their prevalence. To describe the patterns of mass public shootings, I conclude by reporting incident and offender characteristics.

1 | MASS MURDER: SOCIAL CONSTRUCTION OF A "NEW" CRIME PROBLEM

Whereas the objectivist approach can be used to define social problems in terms of their objective conditions, the social constructionist perspective can be used to maintain that social problems are the product of "the activities of individuals and groups making assertions of grievances and claims with respect to some putative conditions" (Spector & Kitsuse, 1977, p. 75). The news media are invariably the primary means through which social problems are constructed, either by making claims directly (i.e., primary claimsmaking) or, more frequently, by reporting the claims made by others (i.e., secondary claimsmaking). Prior research findings have revealed that the "discovery" of a new crime problem is often triggered by the occurrence of a widely publicized event, or landmark narrative, which ultimately is used to define the essence of the problem (Adler, 1996; Chermak, 2003; Duwe, 2007; Nichols, 1997). When claimsmakers construct a social problem, they usually focus on describing the nature of the problem, how prevalent it is, and what can be done to control it.

In previous research (Duwe, 2005, 2007), I have drawn on the social constructionist perspective to examine how and why mass murder was identified as a new crime problem. Even though research findings have shown that mass murder rates during the 1920s and 1930s were nearly as high as they were from the mid-1960s through the 1990s (Duwe, 2004), there was a paucity of well-known mass killings in the United States prior to the mid-1960s. Therefore, when claimsmakers "discovered" mass murder during the 1980s, the high-profile massacres committed by Richard Speck and Charles Whitman in the summer of 1966 (both of which were referred to as "crimes of the century" at the time they were committed) were seen as the beginning of an unprecedented mass murder wave. From the summer of 1966 to the mid-1980s, which is when claimsmakers began making claims about mass murder, there had been a steady accumulation of well-publicized cases. The Speck and Whitman massacres thus provided claimsmakers with highly visible, familiar, and credible landmark narratives to support the claim that the mid-1960s marked the onset of the age of mass murder.

Although mass murder was, according to claimsmakers, a historically new crime that emerged in the mid-1960s, the nearly two-decade delay in the identification of mass murder as a novel crime problem was a result of the "discovery" of another crime problem—serial murder. Before the 1980s, the term "mass murder" was widely used as a catchall phrase to refer to all incidents in which several persons were killed. Beginning in the latter half of the 1960s, there was a dramatic rise in serial killings, or at least in the number publicized by the media (Jenkins, 1994), which later gave rise to the creation of the serial murder concept in the late 1970s. The creation of this concept narrowed the meaning of the term "mass murder." Popular use of the new, more limited definition was evident as early as 1984, but there was still a tendency, especially early on, to conflate the two types of multiple murder. For claimsmakers, then, it seemed reasonable to assume that mass murder, like serial murder, had increased dramatically since the mid-1960s.

After mass murder was identified as a new crime, claimsmakers characterized what kind of problem it was by relying on the most heavily publicized cases as typifying examples (Duwe, 2005). Existing research findings have demonstrated that even though almost all mass murders are newsworthy, familicides and felony-related massacres are among the least newsworthy (Duwe, 2000). Familicides most often involve a male head of the household killing his partner (i.e., spouse, ex-spouse, or fiancée), their children, relatives, or some combination of these. Familicides almost invariably take place within the privacy of a residential setting, and the offender commits suicide in approximately two thirds of these cases. Felony-related massacres, on the other hand, are mass murders committed in connection with other crimes such as robbery, burglary, gang "turf wars," or contract killings (i.e., mob hits). In contrast to familicides, which are almost always carried out by a lone offender, felony-related massacres are more likely to involve multiple offenders (Duwe, 2007).

The most newsworthy mass murders are more likely to involve an offender who uses a gun, especially an assault weapon, to shoot a large number of stranger victims in a public location (Duwe, 2000). Such cases have been referred to as "mass public shootings," which often dominate the news cycle because they involve, on average, a greater number of killed and injured victims than other mass murders (Duwe, 2007). Previous research findings have demonstrated that the "body count" is the strongest predictor of the extent to which mass killings get reported by the news media (Duwe, 2000). That mass public shooters are more likely than other mass murderers to kill strangers connotes an indiscriminate selection of victims, which increases their newsworthiness by conveying the impression that anyone could be a victim of a mass killing (Duwe, 2000). Furthermore, the audience may be more likely to identify with the victims of mass public shootings, who were simply in the wrong place at the wrong time.

Mass public shootings are also, by their definition, highly visible acts of violence. Because publicly occurring mass murders usually involve people who witnessed and survived the attack, these incidents

frequently give the news media the means to "deliver a fascinating firsthand account to the audience, allowing them to vicariously experience the horror of the event" (Duwe, 2000, p. 391). Mass public shootings are generally more newsworthy than other mass murders because they are "riveting, emotionally evocative incidents" that epitomize "news as theater—a morality play involving pure, innocent victims and offenders who seemingly went 'berserk' in a public setting" (Duwe, 2000, p. 391).

Given the reliance on the highest profile cases as typifying examples, mass public shootings defined the essence of mass murder when it was socially constructed as a new crime problem during the 1980s and 1990s. Indeed, mass murder was widely seen as a gun control, workplace violence, and school shooting problem mainly because mass public shootings involve individuals who use guns to carry out an attack at a public location, such as a school or the workplace. Because perceptions help shape policy recommendations, proposals to reduce mass murder were generally focused on reforming gun laws and school and workplace violence policies (Duwe, 2005). Although mass public shootings were seen as the prototypical mass murder, it is worth emphasizing that they are rare within the context of mass murder, which is itself a rare form of violence.[1] Indeed, mass public shootings make up only 12% of all mass killings (Duwe, 2004, 2007) and a mere .0003% of all homicides annually. In contrast, familicides and felony-related massacres are more common, accounting for nearly 70% of mass murders (Duwe, 2007). Yet, because familicides and felony-related massacres are less newsworthy and, thus, much less likely to have been used as typifying examples, proposals to curb the incidence and/or severity of mass murder are seldom focused on domestic violence, drug policy, or urban crime.

In calling attention to the newly identified mass murder problem in the late 1980s and early 1990s, claimsmakers asserted it was on the rise. To their credit, however, they also emphasized how rare it was, which may have tempered the urgency to "do something" about mass murder (Duwe, 2005). Still, claimsmakers experienced some success in constructing mass murder. The growing number of high-profile mass public shootings during the 1980s and 1990s not only led to the creation of policies designed to address school and workplace violence, but it also provided gun control proponents with opportunities to advance their claims about the need for a federal assault weapons ban (Duwe, 2005, 2007; Koper & Roth, 2001, 2002). For example, after a 1989 mass murder committed in Louisville, Kentucky, with an AK-47 rifle, California congressman Pete Stark warned, "There will be more and more mindless mass murders until the President and Congress put controls on the sales of assault weapons" (*Los Angeles Times*, 1989). In 1994, gun control activists won a major victory with passage of the federal assault weapons ban (AWB). Ten years later, however, the ban was allowed to expire.

2 | MASS SHOOTINGS: NEW NAME FOR AN OLD PROBLEM

At the dawn of this century, the mass murder problem had faded from prominence. Beginning in the mid-2000s, however, a problem bearing a similar, yet slightly different, name emerged to take its place—mass shootings. As Roeder (2016) demonstrated, the news media's use of the phrase "mass shooting" has increased dramatically during the last 10 years. In fact, prior to the 2000s, it had hardly been used at all.

Just as mass public shootings were central to the social construction of mass murder in the 1980s and 1990s, the same is true for the mass shooting problem over the last decade. From the 2007 massacre at Virginia Tech to the 2018 Parkland school shooting, it has been the catastrophic, high-profile mass public shootings, as defined here, that have galvanized the public and epitomized the essence of the mass shooting problem. Whereas mass public shootings were generally referred to as "mass murders"

prior to the 2000s, they have, since the mid-2000s, typically been labeled as "mass shootings." The term "mass shooting" is therefore a new name for a familiar problem as it has supplanted "mass murder" as the new crime category under which mass public shootings fall (Duwe, 2018).

Given the importance of mass public shootings to the social construction of both problems, mass shootings have, to a large extent, been typified in much the same way that mass murders were in the 1980s and 1990s (Duwe, 2018). Because the typification process involves influencing perceptions, which, in turn, are then used to shape the solutions offered for a problem, we see that—like the mass murder problem—the policy proposals to control mass shootings have continued to be focused on reforming gun legislation and school and workplace violence policies. This similarity notwithstanding, there have been several notable ways in which the social construction of the mass shooting problem has differed from its predecessor.

First, there has been more emphasis placed on the presence of serious mental illness as a result of the high rate observed among mass public shooters (Duwe, 2016), which also highlights a difference in how the mass murder and mass shooting problems have been typified. Although generally absent from the social construction of the mass murder problem, mental health reform has been identified as a strategy to help control mass shootings. More recently, however, there have been efforts to challenge the notion that there is a link between mental health and mass violence.

Second, whereas the mass murder problem emerged prior to the advent of the Internet, the mass shooting problem has been constructed during the age of social media. With the possible exception of the 1966 sniper attack at the University of Texas at Austin, video footage (live or recorded) of mass public shootings that occurred during the twentieth century did not exist. Recently, however, it has not been uncommon for bystanders to capture the terror of a mass public shooting on their phones and later disseminate it on social media. More broadly, the emergence of social media has made it possible for anyone to promulgate claims about a social problem, including mass shootings.

Third, compared with mass murder, there has been much less unanimity in how mass shootings have been defined. With mass murder, the general consensus was that it comprised incidents in which at least three or four victims were murdered within a brief period of time. But as the phrase "mass shooting" has grown in popularity (Roeder, 2016), so have the efforts to define it. In addition to entities such as the Gun Violence Archive, Everytown for Gun Safety, Mass Shooting Tracker, *USA Today*, and *Mother Jones*, several researchers (Krause & Richardson, 2015; Lankford, 2013; Schildkraut & Elsass, 2016) have each developed their own distinct mass shooting definitions. These definitions vary on the basis of the number of victims shot (fatally or nonfatally), the number of victims killed, the location where the shooting took place, the motive for the shooting, whether the manner in which the victims were shot was indiscriminate, and whether the offender is included as one of the victims in the event he or she committed suicide or was killed by police (i.e., suicide by cop). The main purpose behind these efforts at defining mass shootings, of course, has been the collection of data to document their patterns and, more commonly, their prevalence. The methods used to collect data have also varied as the Congressional Research Service (Krause & Richardson, 2015) and *USA Today* (Overberg, Upton, & Hoyer, 2013) used both news reports and the Federal Bureau of Investigation's (FBI's) Supplementary Homicide Reports (SHR) as data sources, whereas others relied strictly on news coverage.

Finally, and perhaps not surprisingly, the various definitions and data collection methods have yielded wildly different findings about the incidence of mass shootings and the trends in their prevalence. Incidence estimates have run the gamut from the single digits to more than several hundred per year, whereas the conclusions reached about recent trends in the prevalence of mass shootings have ranged from an increase to no increase at all.

3 | DATA AND METHOD

The data on mass shootings (including mass public shootings) in the United States come from two main sources: the FBI's SHR and news coverage. The SHR contains incident, victim, and offender information on most murders committed in the United States. The SHR did not become a valuable source of homicide data, however, until it underwent a major revision in 1976 (Riedel, 1999). Therefore, given that 2018 is the most recent year for which SHR data are available, the timeframe for this study covers the 1976–2018 period.

Although the SHR is the most comprehensive source of U.S. homicide data, it has several notable limitations. First, because the SHR is a voluntary program involving law enforcement agencies across the country, an estimated 8% of all homicides are not reported (Fox, 2000). Second, the SHR data frequently contain several coding errors (Duwe, 2000; Wiersema, Loftin, & McDowall, 2000). For example, in a previous study (Duwe, 2000), I found cases in the SHR data where victims were coded twice for the same incident, wounded victims were counted as fatal victims, more than one law enforcement agency reported the same homicide, and offenders were counted as victims in murder-suicides. Finally, the SHR does not include important information such as the location where the homicide took place or the number of wounded victims.

Compared with the SHR, news accounts usually provide more detailed information, including the location where the homicide occurred (e.g., private residence, school, or workplace) and whether any victims were injured. Moreover, given that some murders are not reported to the SHR, the use of news reports can help minimize the underreporting problem. Still, using news coverage as the sole source of data on mass shootings (or mass murders in general) has its own limitations, too. Even though most mass murders, including mass shootings, are reported by the press, many receive limited, mostly local coverage (Duwe, 2000; Overberg et al., 2013). Successful identification of mass shootings that have taken place is therefore highly dependent on the news media database being used, the news organizations included within the database, and the search terms used. Indeed, not all cases are described by the news media as "mass shootings" or "mass murder," which is why it is necessary to also use search terms such as "quadruple shooting", "quintuple homicide", and so on. Moreover, news coverage is generally less accessible for older incidents that occurred farther back in time.

The limitations of relying on a single data source, such as news accounts, to identify mass shootings are apparent when we look at two popular, widely cited sources—*Mother Jones* and the Gun Violence Archive. Relying on SHR data and news accounts as sources of data and using a definition of mass shootings similar to the one used by *Mother Jones*, I found the *Mother Jones* list missed more than 40% of the mass shootings occurring from 1982 to 2013 that ostensibly met its definitional requirements. Furthermore, the underreporting problem with the *Mother Jones* list was more severe for the older cases that took place in the 1980s and 1990s (Duwe, 2014).

Using a broad mass shooting definition—any incident in which a gun was used to kill *and/or* injure four or more victims—the Gun Violence Archive identified 277 incidents that took place in the United States in 2014. Of these, 14 would meet the mass shooting definition used here (i.e., four or more victims killed with a gun in a 24-hour period). In comparison, the data used in this study contain 20 mass shootings that occurred in 2014, which means the Gun Violence Archive missed 30% of the cases in which four or more victims were killed with a firearm.[2]

To identify mass shootings that took place in the United States between 1976 and 2018, I relied on a triangulated data collection strategy that has been used in prior research on mass murder (Duwe, 2000, 2004, 2007; Duwe, Kovandzic, & Moody, 2002; Overberg et al., 2013) and mass shootings (Krause & Richardson, 2015). More specifically, after using the SHR to identify when and where

gun-related mass murders took place, I searched online newspaper databases to collect additional information not included within the SHR, such as the number of injured victims and the specific location where the incident occurred. In doing so, I was able to not only identify cases not reported to the SHR but also correct errors in the SHR data. I also consulted unpublished mass shooting data sets from Brot (2016) and the Congressional Research Service (2014), which added a handful of cases.

The mass shooting definition used here is straightforward, easy to operationalize, and consistent with the definitions used by Fox and Levin (2015), *USA Today* (Overberg et al., 2013), and the Congressional Research Service (Krause & Richardson, 2015). It is different, however, from other popular mass shooting definitions such as those developed by the Gun Violence Archive, Mass Shooting Tracker, or *Mother Jones*, although it is worth pointing out the *Mother Jones* "mass shooting" definition is similar to the mass public shooting definition described earlier.

In defining mass shootings, I did not include other criteria found in these definitions, such as wounded victims or victim selection, for a few reasons. First, even though a reasonable case could be made that "mass shootings" should include incidents in which, say, four victims were wounded and none were murdered, there is no data source currently available that could comprehensively document these types of cases. Although news coverage is, as explained later on, a critical source of data on mass shootings, it has several significant limitations, especially when used as the sole data source, which would be magnified for less severe cases. Moreover, these less severe shootings are not the types of cases that have engendered the recent fear and concern over the mass shooting problem. Second, subjective criteria such as whether victims were indiscriminately targeted is problematic from an operational standpoint. As noted in the next section, even an objective criterion such as location (did the incident occur in a residence or a public setting?) can be challenging to operationalize.

Overall, the mass shooting data set contains 845 incidents that occurred between 1976 and 2018. I further examined these cases to determine which ones met the criteria for classification as a mass public shooting. The main issue in classifying mass public shootings centers on how "public location" is operationalized. Measuring public location somewhat broadly, I considered a public place to be any area outside of a residence, which includes single-family dwellings, duplexes, townhouses, apartments, and so on. There were some mass shootings in which victims were shot in both residential and public settings. In these instances, I considered an incident to have taken place in a public location if at least half of the fatal victims were killed outside of a residence.

Of the 845 mass shootings that occurred in the United States between 1976 and 2018, there were 158, an average of 3.7 per year, that were mass public shootings. As such, a mass public shooting is not only an infrequent form of mass murder, but it is also a rare type of mass shooting. The most common types of mass shootings were familicides and felony-related massacres, which made up nearly three fourths of the cases.

The more detailed news reports were used to record additional data on the 158 mass public shootings, including the presence of mental illness, precipitating events, the communication of threats, and the outcome of the case. More specifically, I examined the available news accounts to determine whether the offender had communicated threats, experienced a precipitating event such as the loss of a job or relationship, been diagnosed with a mental disorder, seen a mental health professional, or been observed by family, friends, or acquaintances to have experienced mental health problems.

The incidence and severity trend data presented in this article are expressed on a per capita basis. Rather than using the conventional per 100,000 rate, I used an annual rate of 100 million in the U.S. population as a result of the rarity of mass shootings. Furthermore, to illustrate trends over time better, I present the rates in terms of 3-year, 5-year, and 10-year moving averages.

4 | TRENDS IN THE PREVALENCE AND SEVERITY OF MASS SHOOTINGS

Table 1 shows data on the prevalence and severity of mass shootings during the 1976–2018 period. For each prevalence and severity measure, I bolded the highest value and bolded and underlined the lowest value. For example, the smallest annual number of mass shootings (9) was observed twice—once in 1979 and one more time in 1985. The "*N*" value is bolded and underlined for both years. Conversely, the "*N*" value of 31 is bolded for 1993, which had more mass shootings than any other year during the 43-year period. Therefore, not surprisingly, 1993 had the highest rate (12.02 per 100 million), whereas 1985 had the lowest rate (3.77 per 100 million). The average mass shooting rate for the 1976–2018 period was 7.26.

When we look at trends in the mass shooting rate over time, we see the highest rates were generally observed during the 1990s. The highest 3-year average (11.20) was 1991–1993, the highest 5-year average (9.72) was 1989–1993, and the 1990–1999 and 1991–2000 periods tied for the highest 10-year average (8.17). The lowest rates, on the other hand, were generally observed during the 1980s. For example, the 1985–1987 and 1984–1988 periods had the lowest 3-year and 5-year averages, respectively. It is worth noting, however, that the 1996–2005 period had the lowest 10-year average, which aligns with broader trends observed for crime and violence in the United States. This finding is similar to those from prior research that demonstrated the trends in the per capita prevalence of mass murder over the 1900–1999 period generally mirrored those for homicides in general (Duwe, 2004).

The data on the severity of mass shootings show 4,203 victims were killed, an average of 98 per year, whereas the total number of victims shot was 6,168, an annual average of 143. The average annual rate of victims killed per 100 million over the 1976–2018 period was 35.87, and the average annual rate of total victims shot was 51.18.

The trend data reveal the highest rates of victims killed were generally in the early 1990s, whereas the highest rates of victims shot have been observed most recently. The highest annual rate of victims killed was in 1991, and the 1991–1993 and 1989–1993 periods had the highest 3- and 5-year averages. The 2008–2017 period had the highest 10-year average, which is more consistent with trend data on the number of victims shot.

As a result of the magnitude of the Las Vegas massacre, 2017 had the greatest number of victims shot and the highest annual rate for this measure. Moreover, the 2015–2017 period had the highest 3-year average, whereas the most recent 5- and 10-year periods had the highest averages. In contrast, the lowest 3-year averages for victims killed and shot were observed in the late 1970s. The lowest 5- and 10-year averages for victims killed and shot were found in the late 1990s and early 2000s.

5 | TRENDS IN THE PREVALENCE AND SEVERITY OF MASS PUBLIC SHOOTINGS

As shown in Table 2, 158 mass public shootings occurred between 1976 and 2018, which amounts to an average of nearly 4 per year and an annual rate of 1.32 per 100 million. Except for 1979, at least one mass public shooting occurred each year during the 43-year period. As such, 1979 had the lowest annual rate. There were 3 years (1993, 1999, and 2012) in which seven mass public shootings took place in the United States. With 10 incidents, however, 2018 had the highest annual rate (3.07).

TABLE 1 Trends in the prevalence and severity of mass shootings, 1976–2018

	Incidence					Victims Killed					Victims Shot				
Year	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr
1976	17	7.92				76	35.40				79	36.80			
1977	19	8.78				85	39.29				106	49.00			
1978	10	4.59	7.10			44	20.18	31.62			44	20.18	35.33		
1979	**9**	4.09	5.82			39	17.72	**25.73**			39	17.72	**28.97**		
1980	23	10.21	6.29	7.12		96	42.60	26.83	31.04		113	50.14	29.35	34.77	
1981	17	7.42	7.24	7.02		79	34.48	31.60	30.85		104	45.39	37.75	36.49	
1982	26	11.23	9.62	7.51		131	56.58	44.55	34.31		142	61.33	52.29	38.95	
1983	15	6.41	8.35	7.87		76	32.48	41.18	36.77		83	35.47	47.40	42.01	
1984	18	7.62	8.42	8.58		104	44.04	44.37	42.04		137	58.01	51.61	50.07	
1985	**9**	**3.77**	5.93	7.29	7.20	**37**	**15.50**	30.67	36.61	33.83	**38**	**15.92**	36.47	43.22	39.00
1986	15	6.25	5.88	7.06	7.04	76	31.65	30.40	36.05	33.45	86	35.81	36.58	41.31	38.90
1987	17	6.98	**5.67**	6.21	6.86	134	55.05	34.07	35.74	35.03	153	62.86	38.20	41.61	40.28
1988	14	5.70	6.31	**6.06**	6.97	60	24.41	37.04	34.13	35.45	76	30.92	43.20	40.70	41.36
1989	21	8.46	7.05	6.23	7.40	94	37.87	39.11	32.90	37.47	143	57.61	50.46	40.62	45.35
1990	16	6.43	6.86	6.76	7.03	70	28.15	30.14	35.42	36.02	81	32.57	40.36	43.95	43.59
1991	30	11.90	8.93	7.89	7.47	150	**59.48**	41.83	40.99	38.52	187	74.15	54.78	51.62	46.47
1992	25	9.80	9.38	8.46	7.33	109	42.73	43.45	38.53	37.14	141	55.28	54.00	50.10	45.86
1993	**31**	**12.02**	**11.2**	**9.72**	7.89	144	55.83	**52.68**	**44.81**	39.47	187	72.51	67.31	58.42	49.56
1994	15	5.76	9.19	9.18	7.71	62	23.81	40.79	42.00	37.45	92	35.34	54.37	53.97	47.30
1995	20	7.61	8.46	9.42	8.09	91	34.63	38.09	43.30	39.36	103	39.20	49.01	55.30	49.62
1996	16	6.03	6.47	8.25	8.07	69	26.01	28.15	36.60	38.80	78	29.40	34.65	46.34	48.98
1997	18	6.73	6.79	7.63	8.04	76	28.40	29.68	33.74	36.13	89	33.25	33.95	41.94	46.02
1998	17	6.29	6.35	6.48	8.10	74	27.38	27.26	28.05	36.43	110	40.70	34.45	35.58	47.00

(Continues)

TABLE 1 (Continued)

	Incidence					Victims Killed					Victims Shot				
Year	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr
1999	25	9.17	7.39	7.17	**8.17**	132	48.41	34.73	32.96	37.48	190	69.68	47.88	42.45	48.21
2000	18	6.40	7.28	6.92	**8.17**	86	30.56	35.45	32.15	37.72	94	33.40	47.92	41.29	48.29
2001	13	4.56	6.71	6.63	7.44	53	18.58	32.51	30.66	33.63	60	21.03	41.37	39.61	42.98
2002	22	7.64	6.20	6.81	7.22	97	33.68	27.61	31.72	32.73	107	37.16	30.53	40.39	41.17
2003	29	9.97	7.39	7.55	7.02	125	42.99	31.75	34.84	31.44	154	52.96	37.05	42.84	39.21
2004	15	5.11	7.57	6.73	6.95	69	23.50	33.39	29.86	31.41	80	27.24	39.12	34.36	38.40
2005	16	5.40	6.83	6.53	**6.73**	76	25.63	30.71	**28.87**	**30.51**	90	30.35	36.85	**33.75**	**37.52**
2006	22	7.35	5.95	7.09	6.86	103	34.40	27.84	32.04	31.35	112	37.41	31.67	37.02	38.32
2007	19	6.30	6.35	6.82	6.82	116	38.46	32.83	33.00	32.36	151	50.06	39.27	39.61	40.00
2008	26	8.55	7.40	6.54	7.04	119	39.14	37.33	32.23	33.53	147	48.35	45.27	38.68	40.76
2009	24	7.82	7.56	7.08	6.91	132	43.00	40.20	36.13	32.99	181	58.96	52.45	45.03	39.69
2010	17	5.50	7.29	7.10	6.82	82	26.51	36.21	36.30	32.59	101	32.65	46.65	45.48	39.62
2011	24	7.70	7.01	7.17	7.13	115	36.91	35.47	36.80	34.42	152	48.78	46.80	47.76	42.39
2012	20	6.37	6.52	7.19	7.01	122	38.86	34.09	36.88	34.94	195	62.12	47.85	50.17	44.89
2013	24	7.59	7.22	7.00	6.77	112	35.43	37.07	36.14	34.18	132	41.76	50.89	48.85	43.77
2014	20	6.27	6.75	6.69	6.88	91	28.54	34.28	33.25	34.69	113	35.44	46.44	44.15	44.59
2015	24	7.47	7.11	7.11	7.08	133	41.39	35.12	36.22	36.26	193	60.06	45.75	49.63	47.56
2016	25	7.72	7.15	7.15	7.08	162	50.00	39.98	38.84	37.82	242	74.69	56.73	54.81	51.29
2017	23	7.09	7.43	7.43	7.23	**180**	55.50	48.96	42.17	**39.53**	**1,081**	**333.3**	**156.0**	109.1	79.61
2018	21	6.44	7.08	7.00	7.00	122	37.42	47.64	42.57	39.36	182	55.83	154.6	**111.9**	**80.36**
Total	845					4,203					6,168				
Avg.	19.65	7.26	7.26	7.29	7.28	97.74	35.87	35.67	35.58	35.40	143.44	51.18	49.06	47.28	45.82

Note. Highest values were bolded; lowest values were bolded and underlined.

TABLE 2 Trends in the prevalence and severity of mass public shootings, 1976–2018

	Incidence					Victims Killed					Victims Shot				
Year	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr
1976	1	0.47				7	3.26				9	4.19			
1977	3	1.39				18	8.32				24	11.09			
1978	1	0.46	0.77			4	1.83	4.47			4	1.83	5.71		
1979	**0**	**0.00**	0.62			**0**	**0.00**	3.38			**0**	**0.00**	**4.31**		
1980	4	1.78	0.74	0.82		18	7.99	**3.27**	4.28		33	14.64	5.49	**6.35**	
1981	3	1.31	1.03	0.99		14	6.11	4.70	4.85		36	15.71	10.12	8.66	
1982	6	2.59	1.89	1.23		34	14.69	9.60	6.13		41	17.70	16.02	9.98	
1983	2	0.85	1.59	1.31		12	5.13	8.65	6.78		14	5.98	13.13	10.81	
1984	5	2.12	1.85	1.73		42	17.78	12.54	10.34		66	27.95	17.21	16.40	
1985	1	0.42	1.13	1.46	1.14	4	1.68	8.20	9.08	6.68	5	2.09	12.01	13.89	10.12
1986	1	0.42	0.98	1.28	1.13	14	5.83	8.43	9.02	6.94	20	8.33	12.79	12.41	10.53
1987	1	0.41	**0.42**	0.84	1.04	6	2.47	3.32	6.58	6.35	16	6.57	5.67	10.19	**10.08**
1988	4	1.63	0.82	1.00	1.15	57	23.19	10.49	10.19	8.49	69	28.07	14.32	14.60	12.71
1989	2	0.81	0.95	0.74	1.23	13	5.24	10.30	7.68	9.01	56	22.56	19.07	13.53	14.96
1990	1	0.40	0.95	**0.73**	1.10	9	3.62	10.68	8.07	8.57	13	5.23	18.62	14.15	14.02
1991	5	1.98	1.06	1.05	1.16	40	15.86	8.24	10.07	9.55	74	29.34	19.04	18.35	15.38
1992	3	1.18	1.19	1.20	**1.02**	14	5.49	8.32	10.68	8.63	25	9.80	14.79	19.00	14.59
1993	7	2.71	1.96	1.42	1.21	35	13.57	11.64	8.76	9.47	73	28.31	22.48	19.05	16.83
1994	1	0.38	1.42	1.33	1.03	4	1.54	6.87	8.02	7.85	27	10.37	16.16	16.61	15.07
1995	3	1.14	1.41	1.48	1.11	14	5.33	6.81	8.36	8.21	18	6.85	15.18	16.93	15.54
1996	2	0.75	0.76	1.23	1.14	10	3.77	3.55	5.94	8.01	14	5.28	7.50	12.12	15.24
1997	3	1.12	1.01	1.22	1.21	12	4.48	4.53	5.74	8.21	21	7.85	6.66	11.73	15.37
1998	3	1.11	0.99	0.90	1.16	13	4.81	4.35	**3.99**	6.37	48	17.76	10.29	9.62	14.33

(Continues)

TABLE 2 (Continued)

	Incidence					Victims Killed					Victims Shot				
Year	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr	*N*	Rate	3-Yr	5-Yr	10-Yr
1999	7	2.57	1.60	1.34	1.34	52	19.07	9.45	7.49	7.75	105	38.51	21.37	15.25	15.93
2000	3	1.07	1.58	1.32	1.40	17	6.04	9.97	7.64	8.00	18	6.40	20.89	15.16	16.05
2001	4	1.40	1.68	1.45	1.34	17	5.96	10.36	8.07	7.01	26	9.11	18.00	15.92	14.02
2002	1	0.35	0.94	1.30	1.26	4	1.39	4.46	7.45	6.60	6	2.08	5.86	14.77	13.25
2003	4	1.38	1.04	1.35	1.13	19	6.53	4.63	7.80	**5.89**	20	6.88	6.02	12.60	11.11
2004	3	1.02	0.91	1.04	1.19	15	5.11	4.34	5.01	6.25	26	8.86	5.94	6.67	10.96
2005	4	1.35	1.25	1.10	1.21	24	8.09	6.58	5.42	6.53	35	11.80	9.18	7.75	11.45
2006	5	1.67	1.35	1.15	1.30	27	9.02	7.41	6.03	7.05	36	12.02	10.90	8.33	12.13
2007	6	1.99	1.67	1.48	1.39	57	18.90	12.00	9.53	8.49	87	28.84	17.56	13.68	14.23
2008	6	1.97	1.88	1.60	1.48	30	9.87	12.59	10.20	9.00	59	19.40	20.09	16.19	14.39
2009	6	1.95	1.97	**1.79**	1.41	46	14.99	14.58	12.17	8.59	84	27.36	25.20	19.89	13.28
2010	4	1.29	1.74	1.78	1.44	20	6.47	10.44	11.85	8.63	31	10.02	18.93	19.53	13.64
2011	4	1.28	1.51	1.70	1.43	23	7.38	9.61	11.52	8.77	49	15.73	17.70	20.27	14.30
2012	7	2.23	1.60	1.75	1.61	67	21.34	11.73	12.01	10.77	148	47.14	24.30	23.93	18.81
2013	4	1.27	1.59	1.61	1.60	27	8.54	12.42	11.74	10.97	33	10.44	24.43	22.14	19.16
2014	3	0.94	1.48	1.40	1.59	14	4.39	11.42	9.62	10.90	33	10.35	22.64	18.74	19.31
2015	4	1.24	1.15	1.39	1.58	37	11.51	8.15	10.63	11.24	73	22.72	14.50	21.27	20.40
2016	4	1.23	1.14	1.38	1.54	65	20.06	11.99	13.17	12.35	131	40.43	24.50	26.22	23.24
2017	7	2.16	1.55	1.37	1.56	**106**	**32.68**	21.42	15.44	13.72	**1,001**	**308.7**	123.9	78.52	51.22
2018	10	**3.07**	**2.15**	1.73	**1.67**	78	23.93	**25.56**	**18.51**	**15.13**	133	40.80	**130.0**	**84.59**	**53.36**
Total	158					1,139					2,840				
Avg.	3.67	1.32	1.30	1.31	1.30	26.49	9.38	9.06	8.87	8.71	66.05	22.44	20.21	18.35	16.91

Note. Highest values were bolded; lowest values were bolded and underlined.

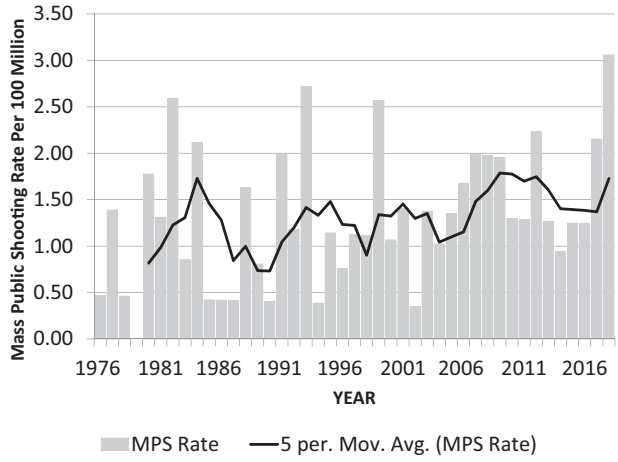

FIGURE 1 Mass public shooting incident rate per 100 Million, 1976–2018

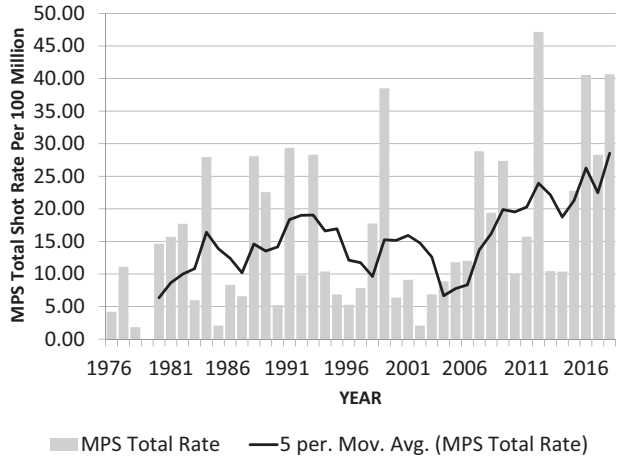

FIGURE 2 Mass public shooting severity rate per 100 million, 1976–2018

The trend data indicate the latter 1980s had lower average rates of mass public shootings. For example, the 1985–1987 period had the lowest 3-year average (.42), the 1986–1990 period had the lowest 5-year average (.73), and the 1983–1992 period had the lowest 10-year average (1.02). As shown in Figure 1, which includes the 5-year moving average, the highest mass public shooting rates have, to a large extent, been observed most recently. Although the 2005–2009 period had the highest 5-year average (1.79), the most recent 3- and 10-year periods had the highest average rates.

Much like the incidence data, the trend data for the number of victims killed and shot further reveal that mass public shootings have recently increased in severity (see Figure 2). A total of 2,840 victims were shot in the 158 mass public shootings, of whom 1,139 were killed. Again, as a result in no small part of the Las Vegas massacre, 2017 had the largest number of victims killed (106) and shot (1,001). As a result, 2017 also had the highest rate of victims killed (32.68) and shot (308.70). Likewise, the most recent 3-year (2016–2018), 5-year (2014–2018), and 10-year (2009–2018) periods had the highest average rates for victims killed and shot.

6 | PATTERNS OF MASS PUBLIC SHOOTINGS

As mentioned earlier, the carnage in mass public shootings is greater than it is for mass killings in general. For example, the average number of victims killed and wounded in 909 mass murders that occurred in the United States from 1900 to 1999 was 5.4 and 4.0, respectively (Duwe, 2007). In Table 3, which presents descriptive statistics on the 158 mass public shootings, the average number of victims killed was 7.21 and the average number wounded was 10.77.

Like those who commit familicide, mass public shooters almost always act alone. Mass public shootings, like the ones committed at Columbine and San Bernardino, are rare. Of the 158 cases, 153 (97%) were carried out by a lone offender. With the exception of three incidents, all of which have occurred since 2006, mass public shooters have been male. A little more than three fifths have been non-Hispanic White offenders, whereas close to one fifth have been African American. The average age among mass public shooters is 35. More than 80% were younger than age 45 at the time of the attack.

School shootings have captured much of the recent attention focused on mass shootings. As shown in Table 3, a little more than one tenth of mass public shootings could be classified as school shootings. Part of the reason for the low percentage of school shootings among mass public shootings in general is a result of the fact that few occurred prior to the late 1990s. Historically, workplace shootings have been more prevalent, accounting for 27% of the cases. The remaining 61% fall into the "other" category, which includes cases such as the 2016 Orlando massacre or the 2017 Las Vegas attack.

Although not all mass public shooters have a history of mental illness, a little more than 60% of the mass public shooters had been either diagnosed with a mental disorder or demonstrated signs of serious mental illness prior to the attack. This rate is not only higher than what has been observed for mass murderers in general (Duwe, 2016; Fox & Fridel, 2016; Taylor, 2018), but it is also consistent with *Mother Jones*'s initial reporting in which it was found that 61% of the 62 cases in the sample had displayed signs of possible mental health problems. The rate for mass public shooters is much higher than what has been reported for the population in general. It is more than three times higher than the 12-month prevalence rate of any mental illness among adults and about 15 times higher than that for serious mental illness (Substance Abuse and Mental Health Services Administration, 2013).

Of the mentally ill mass public shooters, approximately one third sought or received mental health care prior to the attack. As shown in Table 3, paranoid schizophrenia has been the most common mental disorder followed by mood disorders. Perhaps as a consequence of the high rate of mental illness and, more narrowly, paranoid schizophrenia, mass public shooters often believe they have been persecuted. For most mass public shooters, the attack is an act of vengeance against those whom the shooter holds responsible for his or her perceived mistreatment. Because mass public shooters generally feel as though others are out to get them, it is perhaps unsurprising that they are often distrustful and socially isolated, which may help explain why they are frequently characterized as "loners" (Duwe, 2007).

Contrary to popular perception that these offenders "just snap," mass public shootings are usually preceded by a great deal of planning and deliberation. As mass public shooters ruminate over the idea of exacting revenge and begin devising plans for their attack, they sometimes communicate threats either verbally or in writing. As shown in Table 3, at least 37% made some form of violent threats beforehand. Even though mass public shooters often spend weeks, months, or years contemplating the attack, approximately two thirds experience a traumatic event—typically the loss of a job or an important relationship—that ultimately precipitates the violence. When mass public shooters carry

TABLE 3 Description of mass public shootings, 1976–2018

Metrics		
Average Number Killed	7.21	
Average Number Wounded	10.77	
Number of Offenders	Number	Percent
Single Offender	153	96.8
Multiple Offenders	5	3.2
Type		
School	18	11.4
Workplace	43	27.2
Other	97	61.4
Gender		
Male	155	98.1
Female	3	1.9
Race/Ethnicity		
Non-Hispanic White	97	61.4
African American	30	19.0
American Indian	3	1.9
Asian	11	7.0
Hispanic	15	9.5
Missing/Unknown	2	1.3
Age Categories		
Younger than 25	41	25.9
25–34	43	27.2
35–44	46	29.1
45–54	17	10.8
55 and older	9	5.7
Missing	2	1.3
Mental Health/Illness		
Yes	97	61.4
Paranoid Schizophrenia	55	34.8
Mood Disorder (Depression)	34	21.5
Other Mental Illness	8	5.1
Unknown	61	38.6
Precipitating Event		
Yes	103	65.2
Unknown	55	34.8
Threats (Verbal or Written)		
Yes	59	37.3
No or unknown	99	62.7
Outcome		
Arrested	66	42.9
Suicide	66	41.8
Killed by Police/Civilians	24	15.2
Unknown	2	1.3
Total N	158	

out the attack, they are more likely to target strangers compared with other mass murderers (Duwe, 2007).

After the shootings, 57% of mass public shooters committed suicide or forced others (mostly police) to kill them. The rate of suicidal behavior among mass public shooters is nearly double the rate for other mass killers and more than 10 times higher than that observed for homicide offenders in general (Duwe, 2007). The high suicide rate may be a result of the fact that many mass public shooters are tormented individuals who want to put an end to their lives of pain and misery but only after evening the score with those who were, in their minds, the sources of that pain and misery.

Given that mass public shooters are often suicidal, the recent rise in the incidence of these cases follows a broader trend of growth in the suicide rate in the United States. After bottoming out with a rate (per 100,000) of 10.4 in 2000, the rate climbed to 14.0 in 2017, with much of the growth taking place since the late 2000s (Hedegaard, Curtin, & Warner, 2017). The rate (57%) at which mass public shooters commit suicide or force others—usually the police—to kill them at the scene of the attack also dovetails with the high rate of mental disorders (61%) discussed earlier. The findings reported in the literature have consistently demonstrated an association between mental disorders and suicide (Arsenault-Lapierre, Kim, & Turecki, 2004). Even though mental illness is not a cause of suicide, it is widely recognized as a risk factor. Therefore, the same may be true for mass public shootings—a mental disorder may not have a causal relationship with this specific form of mass violence, but it could elevate the risk.

7 | CONCLUSION

After the mass murder problem receded during the late 1990s, the mass shooting problem has emerged over the last decade. Despite differences in how each one has been socially constructed, both have been driven by mass public shootings, which are rare within the context of either mass shootings or, more broadly, mass murder. When mass murder was constructed as a new crime problem, the height of claimsmaking activity was during the late 1980s and early 1990s (Duwe, 2007), which coincides with what had been—until recently—the highest incidence rates observed for mass public shootings since the mid-1970s. Likewise, the more recent mass shooting problem has arisen during a time in which the incidence and severity of mass public shootings have been on the rise.

The growing number of highly lethal mass public shootings raises several important questions. Perhaps most notably, why have they become more deadly since the mid-2000s? Is this effect a result of the expiration of the federal assault weapons ban in 2004? Or is it a result of other changes in gun policy? Would greater access to mental health care have an impact on the incidence of mass public shootings or mass killings in general? To what extent does the widespread media coverage incite, or inspire, others to carry out attacks?

As the public debate continues over what can be done to reduce the incidence and severity of mass public shootings, it is worth reiterating that this type of violence is, fortunately, rare. Emphasizing their rarity does not diminish the enormous impact they have on perceptions of public safety. The infrequency with which they occur, however, makes it challenging to predict with accuracy who will commit a mass public shooting or to develop policies designed to reduce their incidence or severity. Therefore, as Fox and DeLateur (2014) suggested, it may be unrealistic to assume that policy proposals targeting mass shootings in particular would, individually or collectively, prevent a catastrophic attack from ever taking place in the future. Rather than crafting measures to attempt to address mass public shootings, it may be more effective to focus on strategies that have shown promise in reducing violence in general.

ENDNOTES

[1] Since 1976, more than 1,000 mass murders have occurred in the United States, averaging close to 30 incidents per year. During the same period of time in the United States, there have been, on average, a little more than 14,000 homicides annually. Mass murders thus account for only .2% of all homicides annually (Duwe, 2016).

[2] The extent of the underreporting problem for the overall Gun Violence Archive (GVA) data is likely worse than 30%. The GVA data follow a heavy-tail distribution in which most of the incidents have smaller numbers of victims, whereas only 5% had four or more fatal victims. Previous research findings have shown that the number of victims killed has a significant positive effect on the newsworthiness of a homicide (Duwe, 2000; Johnstone, Hawkins, & Michener, 1994; Wilbanks, 1984). What this means is that cases falling in the flat tail of the distribution (i.e., those with four or more fatal victims) are more likely to get reported by the news media than are those with fewer fatal (or no fatal) victims, which make up the bulk of the cases in the GVA data set. Therefore, if the GVA data missed 30% of the most newsworthy cases, the percentage of missing cases is likely higher for the less severe shootings either because they received minimal news coverage or were never reported at all.

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REFERENCES

Adler, J. S. (1996). The making of a moral panic in 19th-century America: The Boston garroting hysteria. *Deviant Behavior: An Interdisciplinary Journal*, *17*, 259–278.

Arsenault-Lapierre, G., Kim, C., & Turecki, G. (2004). Psychiatric diagnoses in 3,275 suicides: A meta-analysis. *BMC Psychiatry*, *4*(4), 37.

Brot, R. (2016). Unpublished mass shooting dataset.

Chermak, S. M. (2003). *Searching for a Demon: The media construction of the militia movement*. Boston: Northeastern University Press.

Cohen, A. P., Azrael, D., & Miller, M. (2014). Rate of mass shootings has tripled since 2011, Harvard research shows. *Mother Jones*. Retrieved from http://www.motherjones.com/politics/2014/10/mass-shootings-increasing-harvard-research

Congressional Research Service. (2014). Unpublished mass public shooting dataset.

Duwe, G. (2000). Body-count journalism: The presentation of mass murder in the news media. *Homicide Studies*, *4*, 364–399.

Duwe, G. (2004). The patterns and prevalence of mass murder in twentieth-century America. *Justice Quarterly*, *21*, 729–761.

Duwe, G. (2005). A circle of distortion: The social construction of mass murder in the United States. *Western Criminology Review*, *6*, 59–78.

Duwe, G. (2007). *Mass murder in the United States: A History*. Jefferson: McFarland and Company, Inc.

Duwe, G. (2014, October 28). The truth about mass public shootings. *Reason.com*. Retrieved from http://reason.com/archives/2014/10/28/the-truth-about-mass-public-shootings

Duwe, G. (2016). The patterns and prevalence of mass public shootings in the United States. In L. Wilson (Ed.), *Handbook of the Psychology of Mass Shootings* (pp. 1915–2013). New York: Wiley.

Duwe, G. (2018). Mass shootings: A new name for a familiar problem. In S. H. Decker & K. A. Wright (Eds.), *Criminology and Public Policy: Putting Theory to Work* (2nd edition, pp. 169–188). Philadelphia: Temple University Press.

Duwe, G., Kovandzic, T., & Moody, C. (2002). The impact of right-to-carry concealed firearms laws on mass public shootings. *Homicide Studies*, *6*, 271–296.

Fox, J. A. (2000). Demographics and U.S. homicide. In A. Blumstein & J. Wallman (Eds.), *The crime drop in America* (pp. 288–317). New York: Cambridge University Press.

Fox, J. A., & DeLateur, M. J. (2014). Mass shootings in America: Moving beyond Newtown. *Homicide Studies*, *18*(1), 125–145.

Fox, J. A., & Fridel, E. E. (2016). The tenuous connections involving mass shootings, mental illness, and gun laws. *Violence and Gender*, *3*(1), 14–19. https://doi.org/10.1089/vio.2015.0054

Fox, J. A., & Levin, J. (2011). *Extreme killing: Understanding serial and mass murder*. Thousand Oaks: Sage.

Fox, J. A., & Levin, J. (2015). Mass confusion surrounding mass murder. *The Criminologist*, *40*, 8–11.

Hedegaard, H., Curtin, S. C., & Warner, M. (2017). *Suicide mortality in the United States, 1999–2017* (NCHS Data Brief, no 330). Hyattsville: National Center for Health Statistics.

Jenkins, P. (1994). *Using murder: The social construction of serial homicide*. Hawthorne: Aldine De Gruyter.

Johnstone, J. W. C., Hawkins, D. F., & Michener, A. (1994). Homicide reporting in Chicago dailies. *Journalism Quarterly*, *71*, 860–872.

Koper, C. S., & Roth, J. A. (2001). The impact of the 1994 Federal Assault Weapon Ban on gun violence outcomes: An assessment of multiple outcome measures and some lessons for policy evaluation. *Journal of Quantitative Criminology*, *17*, 33–74.

Koper, C. S., & Roth, J. A. (2002). The impact of the 1994 Federal Assault Weapon Ban on gun markets: An assessment of the short-term primary and secondary market effects. *Journal of Quantitative Criminology*, *18*, 239–266.

Korte, G. (2016). Obama: Mass shootings should dominate the news. *USA Today*. Retrieved from http://www.usatoday.com/story/news/politics/2016/02/26/obama-mass-shootings-should-dominate-news/80995514/

Krause, W. J., & Richardson, D. J. (2015). *Mass murder with firearms: Incidents and victims, 1999–2013*. Washington: Congressional Research Service.

Lankford, A. (2013). *The myth of martyrdom: What really drives suicide bombers, rampage shooters, and other self-destructive killers*. New York: Palgrave Macmillan.

Los Angeles Times (1989, September 15). Louisville mayhem seen spurring gun debate; activists on both sides expect new drive to widen curbs on assault weapons.

Nichols, L. T. (1997). Social problems as landmark narratives: Bank of Boston, mass media and "money laundering". *Social Problems*, *44*, 324–341.

Overberg, P., Upton, J., & Hoyer, M. (2013, December 3). USA Today research reveals flaws in mass-killing data. *USA Today*. Retrieved from http://www.usatoday.com/story/news/nation/2013/12/03/fbi-mass-killing-data-inaccurate/3666953/

Riedel, M. (1999). Sources of homicide data. In M. D. Smith & M. A. Zahn (Eds.), *Studying and preventing homicide: Issues and challenges* (pp. 31–48). Thousand Oaks: Sage.

Roeder, O. (2016). The phrase "mass shooting" belongs to the 21st century. Retrieved from http://fivethirtyeight.com/features/we-didnt-call-them-mass-shootings-until-the-21st-century/

Schildkraut, J., & Elsass, H. J. (2016). *Mass shootings: Media, myths, and realities*. Santa Barbara: Praeger Books.

Spector, M., & Kitsuse, J. I. (1977). *Constructing social problems*. Menlo Park: Cummings.

Substance Abuse and Mental Health Services Administration. (2013). *Results from the 2012 National Survey on Drug Use and Health: Mental Health Findings* [NSDUH Series H-47, HHS Publication No. (SMA) 13-4805]. Rockville: Author.

Taylor, M. A. (2018). A comprehensive study of mass murder precipitants and motivations of offenders. *International Journal of Offender Therapy and Comparative Criminology*, *62*(2), 427–449. https://doi.org/10.1177/0306624X16646805

Wiersema, B., Loftin, C., & McDowall, D. (2000). A comparison of Supplementary Homicide Reports and National Vital Statistics System homicide estimates for U.S. counties. *Homicide Studies*, *4*, 317–340.

Wilbanks, W. (1984). *Murder in Miami: An analysis of homicide patterns and trends in Dade County (Miami) Florida, 1917–1983*. Lanham: University Press of America.

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EXHIBIT 68

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

How Dangerous is Lightning?

Safety
National Program

Lightning is a major cause of storm related deaths in the U.S. A lightning strike can result in a cardiac arrest (heart stopping) at the time of the injury, although some victims may appear to have a delayed death a few days later if they are resuscitated but have suffered irreversible brain damage.

According to *the NWS Storm Data*, over the last 30 years (1989-2018) the U.S. has averaged 43 *reported* lightning fatalities per year. Only about 10% of people who are struck by lightning are killed, leaving 90% with various degrees of disability. More recently, in the last 10 years (2009-2018), the U.S. has averaged 27 lightning fatalities.

Odds of Becoming a Lightning Victim (based on averages for 2009-2018)				
Estimated U.S. population as of 2019				330,000,000
Average Number of Deaths Reported	27	Estimated number of Injuries	243	270
Odds of being struck in a given year (estimated total deaths + estimated injuries)				1/1,222,000
Odds of being struck in your lifetime (Est. 80 years)				1/15,300
Odds you will be affected by someone struck (10 people for every 1 struck)				1/1,530

EXHIBIT 69

Changes in US mass shooting deaths associated with the 1994–2004 federal assault weapons ban: Analysis of open-source data

Charles DiMaggio, PhD, MPH, Jacob Avraham, MD, Cherisse Berry, MD, Marko Bukur, MD, Justin Feldman, ScD, Michael Klein, MD, Noor Shah, MD, Manish Tandon, MD, *and* **Spiros Frangos, MD, MPH**, *New York, New York*

AAST Continuing Medical Education Article

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After reading the featured articles published in the *Journal of Trauma and Acute Care Surgery*, participants should be able to demonstrate increased understanding of the material specific to the article. Objectives for each article are featured at the beginning of each article and online. Test questions are at the end of the article, with a critique and specific location in the article referencing the question topic.

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BACKGROUND: A federal assault weapons ban has been proposed as a way to reduce mass shootings in the United States. The Federal Assault Weapons Ban of 1994 made the manufacture and civilian use of a defined set of automatic and semiautomatic weapons and large capacity magazines illegal. The ban expired in 2004. The period from 1994 to 2004 serves as a single-arm pre-post observational study to assess the effectiveness of this policy intervention.

METHODS: Mass shooting data for 1981 to 2017 were obtained from three well-documented, referenced, and open-source sets of data, based on media reports. We calculated the yearly rates of mass shooting fatalities as a proportion of total firearm homicide deaths and per US population. We compared the 1994 to 2004 federal ban period to non-ban periods, using simple linear regression models for rates and a Poison model for counts with a year variable to control for trend. The relative effects of the ban period were estimated with odds ratios.

RESULTS: Assault rifles accounted for 430 or 85.8% of the total 501 mass-shooting fatalities reported (95% confidence interval, 82.8–88.9) in 44 mass-shooting incidents. Mass shootings in the United States accounted for an increasing proportion of all firearm-related homicides (coefficient for year, 0.7; $p = 0.0003$), with increment in year alone capturing over a third of the overall variance in the data (adjusted $R^2 = 0.3$). In a linear regression model controlling for yearly trend, the federal ban period was associated with a statistically significant 9 fewer mass shooting related deaths per 10,000 firearm homicides ($p = 0.03$). Mass-shooting fatalities were 70% less likely to occur during the federal ban period (relative rate, 0.30; 95% confidence interval, 0.22–0.39).

CONCLUSION: Mass-shooting related homicides in the United States were reduced during the years of the federal assault weapons ban of 1994 to 2004. (*J Trauma Acute Care Surg.* 2019;86: 11–19. Copyright © 2018 American Association for the Surgery of Trauma.)

LEVEL OF EVIDENCE: Observational, level II/IV.

KEY WORDS: Firearms; mass-shootings; assault weapons; epidemiology.

Increases in firearm-related injuries, particularly mass-shooting related fatalities, in the United States have contributed to a polarizing and sometimes contentious debate over gun ownership and limiting weapons characterized as assault weapons.[1,2] Despite the increasing sense that there is an epidemic of indiscriminate firearm violence in our schools and public spaces, there is a paucity of public health evidence on the topic. Among a number of recommendations, a federal Assault Weapons Ban (AWB) has been proposed as a way to prevent and control mass shootings in the United States. In this article, we assess evidence for the effectiveness of such a ban in preventing or controlling mass-shooting homicides in the United States.

While mass shootings occur in other industrialized nations, the United States is particularly prone to these crimes. In a recent 30-year period, the United States had double the number of mass-shooting incidents than the next 24 industrialized nations combined.[3] Any public perception of recent increases in the number of these events is borne out by analysis of available data.[4] By one measure, there have been more deaths due to mass shootings in the United States in the past 18 years than in the entire 20th century.[5] While there is some debate about the role of mental illness in mass shootings,[6–8] many high-profile recent mass shootings (Aurora, CO; Roseburg, OR; San Bernadino, CA; Newtown, CT; Orlando; Las Vegas; Sutherland Springs, TX) have been characterized by the use of semiautomatic assault rifles,[9] leading some to advocate for restrictions on the manufacture and sale of these weapons.

While survey results indicate that researchers in criminology, law and public health rank an assault weapons ban as one of the most effective measures to prevent mass shootings, and that 67% of the US general population support such a ban,[10] the existing evidence on banning assault weapons is scant and sometimes contradictory. Most evidence is related to the Federal AWB of 1994, which made illegal the manufacture and use by civilians of a defined set of automatic and semiautomatic weapons and large capacity magazines. Formally known as "The Public Safety and Recreational Firearms Use Protection Act", the AWB was part of the broader "Violent Crime Control and Law Enforcement Act of 1994. The ban lasted 10 years, expiring in 2004 when the US Congress declined to renew it.

In a study soon following the implementation of the 1994 ban, researchers reported a 55% decrease in the recovery of assault weapons by the Baltimore City Police in the first 6 months of 1995, indicating a statistically significant 29 fewer such firearms in the population.[11] In a 2009 study based on ICD9 external cause of injury codes for patients younger than 18 years in the United States, 11 states with assault and large-capacity magazine bans, as well as other firearm laws, were compared with 33 states without such restrictions. The incidence of firearm injuries per 1,000 total traumatic injuries was significantly lower in states with restrictive laws, 2.2 compared with 5.9.[12] In contrast, a comprehensive 2001 evaluation of the AWB itself concluded that there was "no evidence of reductions in multiple-victim gun homicides or multiple-gunshot wound victimizations". The authors cautioned their results should be "interpreted cautiously" because of the short period since the ban's inception, and that future assessments were warranted.[13] More recent studies, while not primarily addressing the US Federal AWB have found results generally consistent with its effectiveness in preventing mass-shooting fatalities.[14,15]

We believe sufficient time has passed and enough data have accumulated to treat the period from 1994 to 2004 as a naturalistic pre-post observational comparison period for the association of the AWB with changes in mass-shootings in the United States. Because there is no authoritative source or registry, or even a widely agreed upon definition for these incidents, we obtained data from three open source references and restricted our analyses to only those incidents confirmed by all three sources. We assess evidence for the potential effectiveness of such a ban in preventing and controlling mass-shooting homicides in the United States. We hypothesized that the implementation of the Federal AWB contributed to a reduction in mass shooting deaths as measured by the number and rate of mass shooting fatalities before, during, and after the federal AWB.

METHODS

Mass incident shooting data were obtained from three independent, well-documented and referenced online sources: Mother Jones Magazine, the Los Angeles Times and Stanford

University.[16–18] These sources have each been the basis for a number of previous studies.[19–26] Data from the three online open-source references were combined. Analyses were restricted to incidents reported by all three sources. Entries were further restricted to those for which four or more fatalities (not including the shooter) were reported, which meets the strictest definition of mass shootings as defined by the Federal Bureau of Investigation.[27,28] Yearly homicide data were obtained from the US Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System (WISQARS) an online database of fatal and nonfatal injury.[29] Because 2017 data were not yet available in the WISQARS system, data for firearm-related homicide data for that year were obtained from a separate online source.[30]

A variable was created to indicate the 1994 to 2004 period as the federal ban period. We attempted to identify incidents involving assault weapons. An assault weapon has been defined as semiautomatic rifle that incorporates military-style features such as pistol grips, folding stocks, and high-capacity detachable magazines.[31] In this study, assault weapons were identified using the text search terms "AK," "AR," "MCX," "assault," "assault," or "semiautomatic" in a text field for weapon details. These terms were based on descriptions of the federal assault ban legislative language.[32] The total number of mass shooting fatalities and injuries were aggregated by year and merged with the yearly firearm homicide data.

The rate of mass shooting fatalities per 10,000 firearm homicide deaths was calculated. For the years covered by the data sources, we calculated (1) the total and yearly number of mass-shooting incidents that met the strictest criteria and were confirmed by all three sources, (2) the number of all weapon (assault and nonassault weapons) mass-shooting fatalities, and (3) the case-fatality ratio of all-weapon mass-shooting fatalities per 100 total mass-shooting fatalities and injuries. The yearly case-fatality ratio was plotted with overlying Loess line for trend and standard error limits. We also plotted the yearly rate of mass shooting fatalities per 10,000 firearm-related homicides with an overlying simple linear model with year as the predictor for (1) the total period, and (2) for preban, ban, and postban periods.

We evaluated assumptions of normality and linearity of the data using graphical methods such as density plots and Q-Q normal plots as well as summary statistics. We tested the hypothesis that the federal ban period was associated with a decrease in the number and rate of mass-shooting fatalities in the United States with a multiple linear regression model, with total homicide-based mass-shooting fatality rate as the outcome variable, a dichotomous indicator variable for the federal ban period as the predictor variable, and year as a control variable for trend over time. We calculated the relative risk of mass shooting fatalities during the federal ban period compared to nonban periods by using the "epitab" function of the R "epitools" package. This estimate is based on the ratio of the fatality rate during the ban period divided by the fatality rate during the nonban period. All results are presented with two-sided p values with a significance level of 0.05 and/or 95% confidence intervals (CI). We conducted subgroup analysis with data restricted to incidents in which an assault-type weapon was explicitly noted.

We conducted analyses to test the sensitivity of our results to the choice of denominator with linear regression models controlling for trend with yearly rates based on (1) CDC WISQARS homicide data ending in 2016, (2) extrapolated CDC WISQARS homicide data for 2017, and (3) population denominator-based rates. We tested the robustness of our underlying modeling assumptions with an alternate mixed-effects generalized linear model of yearly mass shooting fatality counts with an observation-level random effect to account for overdispersion.

The study was determined to be exempt as nonidentifiable data. The study data and analytic code are available for download at http://www.injuryepi.org/styled-2/.

RESULTS

The three data sources listed incidents ranging in number from 51 (LA Times) to 335 (Stanford) and in dates from 1966 (Stanford) to 2018 (LA Times). There were a total of 51 reported cases of mass shootings between 1981 and 2017 confirmed by all three sources. Forty-four of these incidents met the strictest criteria for mass shootings (4 or more killed), totaling 501 all-weapon fatalities. In total 1,460 persons were injured or killed over the 37-year period, for a total case-fatality ratio of 34.3% (95% CI, 31.9–36.8). The overall rate of mass shooting fatalities per 10,000 firearm-related homicides was 10.2 (95% CI, 9.4–11.2). There was an increase in the all-weapon yearly number of mass-shooting fatalities in the United States during the study period, (Fig. 1) and evidence of a decrease in case fatality in the post-2010 period (Fig. 2). Incidents in which weapons were characterized as assault rifles accounted for 430 or 85.8% of mass-shooting fatalities (95% CI, 82.8–88.9). Weapons characterized as assault rifles accounted for *all* mass-shooting fatalities in 15 (62.5%) of the 24 (95% CI, 42.6–78.9) years for which a mass-shooting incident was reported, accounting for a total of 230 fatalities in those years.

Between 1981 and 2017, mass shootings in the United States accounted for an increasing proportion of all firearm-related homicides, with increment in year accounting for nearly 32% of the overall variance in the data. During the years in which the AWB was in effect, this slope decreased, with an increase in the slope of yearly mass-shooting homicides in the postban period

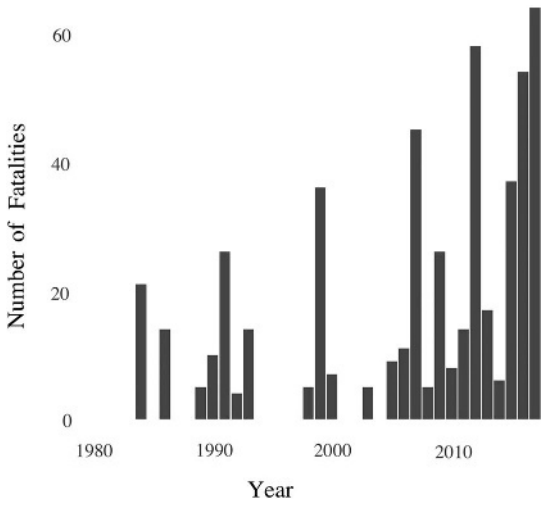

Figure 1. Mass shooting deaths. United States 1981–2017.

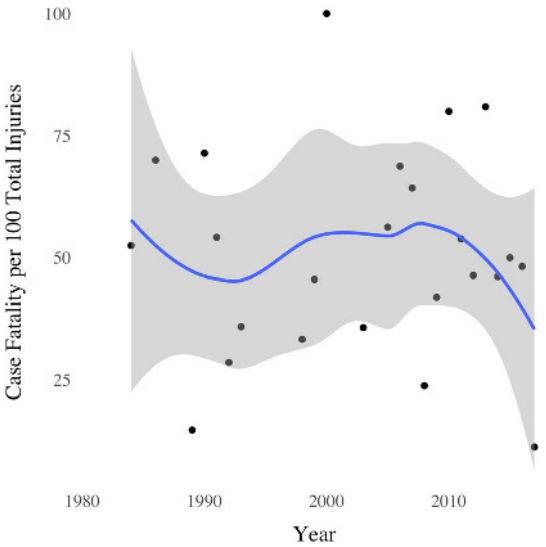

Figure 2. Case fatality per 100 total mass-shooting injuries with loess smoothing line for trend and standard error bounds. United States 1981–2017.

(Fig. 3). A similar pattern was evident in data restricted to those incidents characterized as involving assault weapons (Fig. 4).

In a linear regression model controlling for yearly trend, the federal ban period was associated with a statistically significant 9 fewer mass shooting–related deaths per 10,000 firearm homicides per year (Table 1). The model indicated that year and federal ban period alone accounted for nearly 40% of all the variation in the data (adjusted R^2 = 0.37). A subanalysis

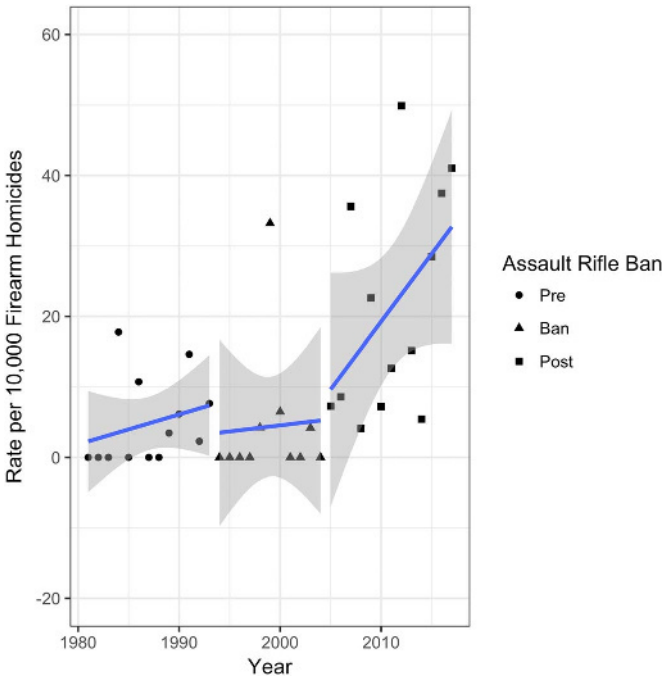

Figure 3. Mass shooting deaths per 10,000 firearm-related homicides with linear trends for preban, ban, and postban periods. United States 1981–2017.

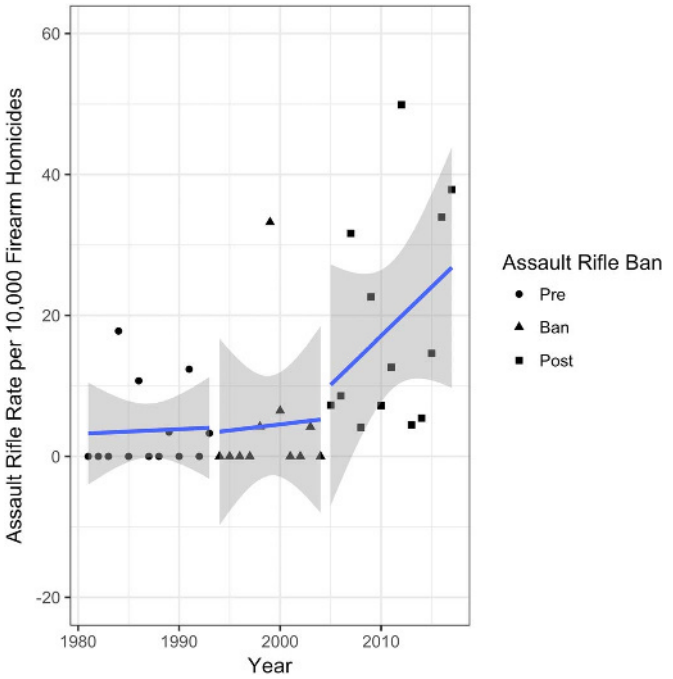

Figure 4. Mass-shooting shooting deaths per 10,000 firearm-related homicides restricted to incidents involving assault weapons with linear trends for preban, ban, and postban periods. United States 1981–2017.

restricted to just those incidents characterized by the use of an assault weapon indicated that seven preventable deaths during the ban period were due to assault weapons alone (Table 2).

The risk of mass shooting fatalities during the federal van period was 53 per 140,515 total firearm homicides compared with 448 per 348,528 during the nonban periods, for a risk ratio of 0.30 (95% CI, 0.22–0.39). The calculated risk ratio for the association of the federal ban period with mass-shooting fatalities as a proportion of all firearm-related homicides was 0.29 (95% CI, 0.22–0.29), indicating that mass shooting fatalities were 70% less likely to occur during the federal ban period.

The results of our sensitivity analyses were consistent with our main analyses for total mass shooting fatalities. In a linear regression analysis controlling for yearly trend and restricted to the period ending in 2016 using just CDC WISQARS homicide data as the denominator, the effect of ban period was associated with a statistically significant eight fewer mass shooting related deaths per 10,000 firearm homicides per year (coefficient for ban period, 8.0; p = 0.05). In a similar model using extrapolated CDC WISQARS homicide data for 2017 instead of Online Gun Violence Archive data as the denominator, the effect of ban

TABLE 1. Linear Regression Effect of 1994–2004 Federal Assault Weapon Ban on Mass-Shooting Deaths per 10,000 Firearm Homicides, United States, 1981–2017

Variable	Estimate	Std. Error	t	p
(Intercept)	−1409.4	333.0	−4.2	0.0002
Year	0.7	0.2	4.3	0.0001
Ban Period	−8.6	3.9	−2.2	0.03

TABLE 2. Linear Regression Effect of 1994–2004 Federal Assault Weapon Ban on Mass-Shooting Deaths Characterized by Use of Assault Weapon per 10,000 Firearm Homicides, United States, 1981–2017

Variable	Estimate	Std. Error	*t*	*p*
(Intercept)	−1219.7	333.9	−3.7	0.0009
Year	0.6	0.2	3.7	0.0008
Ban	−6.7	3.9	−1.7	0.09

period was associated with a statistically significant 9 fewer mass shooting related deaths per 10,000 firearm homicides per year (coefficient for ban period, 8.6; $p = 0.03$). A model based on the total yearly US population as the denominator, the effect of ban period was associated with a statistically significant 0.4 fewer mass shooting related deaths per 10,000,000 population (coefficient for ban period, 0.4; $p = 0.02$).

The results of a mixed-effects generalized linear Poisson model of yearly mass shooting fatality counts with an observation-level random effect to account for overdispersion were very similar whether the offset variable was the number of total firearm deaths or the population size. In either case, the assault weapons ban period was associated with an approximately 85% reduction in mass shooting fatalities (Table 3).

DISCUSSION

Recently, 75% of members of the American College of Surgeons Committee on Trauma endorsed restrictions to "civilian access to assault rifles (magazine fed, semiautomatic, i.e., AR-15),"[33] and 76% of the Board of Governors were in favor of a limit to "… civilian access to ammunition designed for military or law enforcement use (that is, armor piercing, large magazine capacity)."[34] In 2015, the American College of Surgeons joined seven of the largest most prestigious professional health organizations in the United States and the American Bar Association to call for "restricting the manufacture and sale of military-style assault weapons and large-capacity magazines for civilian use."[35] This analysis adds evidence to support these recommendations.

No observational epidemiologic study can answer the question whether the 1994 US federal assault ban was causally related to preventing mass-shooting homicides. However, this study adds to the evidence by narrowly focusing our question on the potential effect of a national assault weapon ban on mass shootings as measured through the lens of case fatality. While the data are amenable to a number of additional analyses, such as stratification by location (e.g. school vs. nonschool) or by characterization of large-capacity magazines versus non large-capacity magazine, we chose to focus only on year of occurrence and total number of fatalities. In this way, we relied on the least subjective aspects of the published reports. We believe our results support the conclusion that the ban period was associated with fewer overall mass-shooting homicides. These results are also consistent with a similar study of the effect of a 1996 ban on assault type weapons in Australia after which mass-shooting fatalities dropped to zero.[36]

While the absolute effects of our regression analyses appears modest (7 to 9 fewer deaths per 10,000 firearm-homicides), it must be interpreted in the context of the overall number of such fatalities, which ranges from none to 60 in any given year in our data. However, if our linear regression estimate of 9 fewer mass shooting–related deaths per 10,000 homicides is correct, an assault weapons ban would have prevented 314 of the 448 or 70% of the mass shooting deaths during the nonban periods under study. Notably, this estimate is roughly consistent with our odds ratio estimate and Poisson model results.

Our results add to the documentation that mass shooting–related homicides are indeed increasing, most rapidly in the postban period, and that these incidents are frequently associated with weapons characterized as assault rifles by the language of the 1994 AWB. We did not find an increase in the case fatality ratio of mass-shooting deaths to mass-shooting injuries. This might at first seem counterintuitive and paradoxical. The destructive effect of these weapons is unequivocal. They are engineered to cause maximum tissue damage rapidly to the greatest number of targets. However, it may be that the use of these kinds of weapons results in indiscriminate injury with additional rounds more likely to injure more people increasing the denominator in a case-fatality ratio. By contrast, the use of nonassault weapons may result in more precise targeting of victims. It is also possible that improvements in trauma care are driving down case fatality.[37] Also, it is worth noting that in absolute terms, there were many more fatalities outside the ban period and that survivable injury comes with its own physical, emotional, and economic costs, which have been estimated at US $32,237 per hospital admission.[38]

Despite US federal funding restrictions on firearm-related research dating to 1996,[39,40] there is a small but growing number of analyses of mass shooting violence in the United States. Many articles have focused on the mental health aspects of these incidents,[41–43] or on social effects like increased firearm acquisition following mass shootings.[44,45] However, fewer studies have taken a strictly public health or clinical approach. Among these, an autopsy-based study of the incidence and severity of mass-shooting casualties concluded the wound patterns differed sufficiently from combat injuries to require new management strategies, indicating there is much to be learned from a systematic epidemiological perspective.[46] Recently, there have been calls to remove such funding restrictions from both academics and elected officials from across the political spectrum.[47,48]

Our choice of data and analytic approach may reasonably be debated. We chose to base our analyses on the yearly rate of mass shooting fatalities per 10,000 overall firearm homicides. This is not a population-based risk estimate, but is in fact a risk as commonly used in the epidemiologic literature which is essentially a probability statement, that is, the number of events

TABLE 3. Exponentiated Coefficients Generalized Linear Poisson Model

	Homicide Offset		Population Offset	
Variable	Estimate	95% CI	Estimate	95% CI
Year	0.6	0.2	3.7	0.0008
Ban	−6.7	3.9	−1.7	0.09

Effect of 1994–2004 federal assault weapon ban on mass-shooting death counts. United States, 1981–20017.

that occurred over the number of times that event could occur. It is the risk of a homicide occurring as a result of a mass shooting. It may be considered a strong assumption to build mass shooting death rates based on the overall firearm homicide rate. The demographics of most homicide victims may differ appreciably from those of mass shooting victims. We selected this approach from among a number of imperfect potential denominators, believing that basing the rates on the number of firearm-homicides partly controls for secular trends in overall homicides and firearm availability. Our sensitivity analyses indicate that our results were robust to most any choice of denominator. We chose linear regression as our primary model because it was straightforward, accessible to most readers, accounted for linear trends in the data, and returned results in the metric in which we were most interested, that is, changes in the rate of fatalities. Our comparative Poisson model results were essentially consistent with the primary model.

These analyses are subject to a number of additional limitations and caveats, primary among which is that there is no authoritative source of data on mass shooting, and any one source may be biased and incomplete. It was for this reason that we chose to combine three independent sources of data, each with its own strengths and weaknesses, and base our analyses only on those numbers that were verified by all three sources. We further restricted our analyses to only the number of fatalities and the year in which the incident occurred, and to the strictest definition of mass shootings as defined by the Federal Bureau of Investigation.[27,28] Even with this approach, the data remain imprecise and subject to differing definitions. We attempted to compensate for this by framing our questions as precisely as possible, following the advice of the scientist and statistician John Tukey to pursue, "… an approximate answer to the right question ...(rather) than the exact answer to the wrong question..."

In this study, we failed to falsify the hypothesis that the AWB was associated with a decrease in mass shooting fatalities in the United States. However, it is important to note that our model did not include important and potentially confounding factors like state-level and local differences in assault weapon laws following the sun downing of the federal AWB. Additional analyses including such variables and using approaches like propensity score matching and regression discontinuity[49] with data further aggregated to state and local levels are necessary to test the strength and consistency of our results.

Federally referenced denominator data were not available for the last year of the study. We chose to use data from the Online Gun Violence Archive to account for firearm homicide in 2017. This resource is a nonpartisan not-for-profit group founded and maintained by a retired computer systems analyst and gun advocate.[50] The alternative would have been to extrapolate from the CDC data, but the 15,593 firearm-related homicides reported by the Online Gun Violence Archive in 2017 was more consistent with the 14,415 reported by CDC in 2016 compared with the 11,599 predicted by an extrapolation and returned more conservative estimates of the increased rate of recent mass shootings. We note there were many years in which the number of mass-shooting fatalities is listed as zero. There were, in fact, fatalities and incidents in those years that could meet a definition of mass shooting, but they were not reported by all three sources, or did not meet the strict criteria we set for this analysis.

An assault weapon ban is not a panacea, nor do our analyses indicate that an assault weapon ban will result in fewer overall firearm-related homicides. It is important to recognize that suicides make up the majority of firearm-related deaths in the United States, accounting for 60.7% of 36,252 deaths from firearms in 2015.[51] However, while this is a critically important issue in its own right, suicides differ fundamentally from mass-shootings, and are unlikely to be affected by an assault weapons ban. Also, compared with the 501 mass-shooting fatalities we counted, there were 489,043 firearm-related homicides in the United States. Public health efforts should be directed at reducing all gun violence and must be multipronged, including targeted initiatives to address mental illness and reducing access to weapons in those with a propensity for violence. However, taken in the context of the increase in mass shootings in the United States, these results support the conclusion that the federal AWB of 1994 to 2004 was effective in reducing mass shooting–related homicides in the United States, and we believe our results support a re-institution of the 1994 federal assault weapons ban as a way to prevent and control mass shooting fatalities in the United States.

DISCLOSURE

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REFERENCES

1. Wolchover N. Why gun control is so contentious in the US. *LiveScience*. 20 July 2012 https://www.livescience.com/21741-gun-control-second-amendment.html. Accessed 10 August 2018.
2. Bond S. Students take the lead in US gun control debate. *Financial Times*. 23 February 2018. https://www.ft.com/content/9341021e-1818-11e8-9376-4a6390addb44. Accessed 10 August 2018.
3. Lemieux F. 6 things to know about mass shootings in America. *Scientific American*. 13 June 2016. https://www.scientificamerican.com/article/6-things-to-know-about-mass-shootings-in-america/. Accessed 6 June 2018.
4. Webster DW. The true effect of mass shootings on Americans. *Annals of Internal Medicine*. 16 May 2017. The http://annals.org/aim/fullarticle/2624992/true-effect-mass-shootings-americans. Accessed 6 June 2018.
5. Katsiyannis A, Whitford DK, Ennis RB. Historical examination of United States intentional mass school shootings in the 20th and 21st centuries: implications for students, schools, and society. *Child Fam Stud*. (19 April 2018). https://doi.org/10.1007/s10826-018-1096-2.
6. Follman M. Mass shootings: maybe what we need is a better mental-health policy. *Mother Jones*. 9 November 2012. https://www.motherjones.com/politics/2012/11/jared-loughner-mass-shootings-mental-illness/. Accessed 11 August 2018.
7. Carey B. "Are mass murderers insane? Usually not, researchers say". *New York Times*. 8 November 2017. https://www.nytimes.com/2017/11/08/health/mass-murderers-mental-illness.html. Accessed 11 August 2018.
8. Duwe G, Rocque M. Actually, there is a clear link between mass shootings and mental illness. *Los Angeles Times*. 23 February 2018. http://www.latimes.com/opinion/op-ed/la-oe-duwe-rocque-mass-shootings-mental-illness-20180223-story.html. Accessed 11 August 2018.
9. Gillin J, Greenberg J, Jacobson L, Valverde M. The facts on mass shootings in the United States. *Politifact*. 8 November 2017. http://www.politifact.com/truth-o-meter/article/2017/nov/08/facts-mass-shootings-united-states/. Access 6 June 2018.
10. Sanger-Katz M, Bui Q. How to reduce mass shooting deaths? Experts rank gun laws. *New York Times*. 5 October 2017. https://www.nytimes.com/interactive/2017/10/05/upshot/how-to-reduce-mass-shooting-deaths-experts-say-these-gun-laws-could-help.html. Accessed 6 June 2018.

11. Weil DS, Knox RC. The Maryland ban on the sale of assault pistols and high-capacity magazines: estimating the impact in Baltimore. *Am J Public Health*. 1997;87(2):297–298.
12. Safavi A, Rhee P, Pandit V, Kulvatunyou N, Tang A, Aziz H, Green D, O'Keeffe T, Vercruysse G, Friese RS, et al. Children are safer in states with strict firearm laws: a national inpatient sample study. *J Trauma Acute Care Surg*. 2014;76(1):146–150; discussion 150–1.
13. Koper CS, Roth JA. The impact of the 1994 Federal Assault Weapon ban on gun violence outcomes: an assessment of multiple outcome measures and some lessons for policy evaluation. *J Quant Criminol*. 2001; Vol. 17, No. 1.
14. Gius M. The impact of state and federal assault weapons bans on public mass shootings. *Applied Economics Letters*. 2015;22(4):281–284.
15. Lemieux F, Bricknell S, Prenzler T. Mass shootings in Australia and the United States, 1981-2013. *Journal of Criminological Research, Policy and Practice*. 1(3):131–142.
16. Follman M, Aronsen G, Pan D, Caldwell M. US mass shootings, 1982-2018: data from mother Jones' investigation. *Mother Jones*. 2012; https://www.motherjones.com/politics/2012/12/mass-shootings-mother-jones-full-data/. Accessed 3 June 2018.
17. The Los Angeles times staff. "Deadliest U.S. mass shootings", 1984-2017. *Los Angeles Times*. Oct 1, 2017, timelines latimes.com/deadliest-shooting-rampages/. Accessed 29 August 2018.
18. Stanford mass shootings in America, courtesy of the Stanford Geospatial Center and Stanford libraries. 2016. Available at: https://library.stanford.edu/projects/mass-shootings-america. Accessed 29 August 2018.
19. Fox JA, Levin J, Fridel EE. *Extreme Killing: Understanding Serial and Mass Murder*. Sage Publications; 2018.
20. Dillon L. *Mass Shootings in the U.S.: An Exploratory Study of the Trends from 1982–2012*. PhD thesis; 2014.
21. Lankford A. Public mass shooters and firearms: a cross-national study of 171 countries. *Violence Vict*. 2016;31(2):187.
22. Lowe SR, Galea S. The mental health consequences of mass shootings. *Trauma Violence Abuse*. 2017;18(1):62–82.
23. Fox JA, Fridel EE. The tenuous connections involving mass shootings, mental illness, and gun laws. *Violence Gend*. 2016;3(1):14–19.
24. Luca M, Malhotra DK, Poliquin C. The impact of mass shootings on gun policy. *Harvard Business School NOM Unit Working Paper No*. 2016;1:16–126.
25. Buchholtz LK. Command-directed mental health evaluations and mental health related discharges from the U.S. military: an argument for command authority. *J Health Care Finance*. 2016.
26. Bradley K. Code blue: the expanding field of tactical/battlefield medicine. *J Law Enforcement*. 2017;6(2).
27. Smart R. Mass shootings: definitions and trends. RAND Corporation. https://www.rand.org/research/gun-policy/analysis/supplementary/mass-shootings.html. Accessed 2 June 2018.
28. Krouse WJ, Richardson DJ. *Mass Murder with Firearms: Incidents and Victims, 1999–2013*. Washington, D.C.: Congressional Research Service, R44126 2015.
29. Centers for Disease Control and Prevention. CDC's WISQARS (web-based injury statistics query and reporting system). https://www.cdc.gov/injury/wisqars/fatal.html. Accessed 12 February 2018.
30. The online gun violence archive: past summary ledgers. http://www.gunviolencearchive.org/past-tolls. Accessed 12 February 2018.
31. Studdert DM, Donohue JJ, Mello MM. Testing the immunity of the firearm industry to tort litigation. *JAMA Intern Med*. 2017;177(1):102–105.
32. Public Safety and Recreational Firearms Act. P.L. 103-322, Title XI. 103rd Cong. (1994).
33. Kuhls DA, Campbell BT, Burke PA, Allee L, Hink A, Letton RW, Masiakos PT, Coburn M, Alvi M, Lerer TJ, et al. Survey of American College of Surgeons Committee on trauma members on firearm injury: consensus and opportunities. *J Trauma Acute Care Surg*. 2017;82(5):877–886.
34. Puls M, Kuhls D, Campbell B, Burke P, Michelassi F, Stewart R. Survey of the American College of Surgeons Board of governors on firearm injury prevention: consensus and opportunities. *Bull Am Coll Surg*. 2017; 102(10):30–36.
35. Weinberger SE, Hoyt DB, Lawrence HC 3rd, Levin S, Henley DE, Alden ER, Wilkerson D, Benjamin GC, Hubbard WC. Firearm-related injury and death in the U.S.: a call to action from 8 health professional organizations and the American Bar Association. *Ann Intern Med*. 2015;162(7):513–516.
36. Chapman S, Alpers P, Jones M. Association between gun law reforms and intentional firearm deaths in Australia, 1979-2013. *JAMA*. 2016;316(3): 291–299.
37. DiMaggio C, Ayoung-Chee P, Shinseki M, Wilson C, Marshall G, Lee DC, Wall S, Maulana S, Leon Pachter H, Frangos S. Traumatic injury in the U.S.: in-patient epidemiology 2000-2011. *Injury*. 2016;47(7):1393–1403.
38. Peek-Asa C, Butcher B, Cavanaugh JE. Cost of hospitalization for firearm injuries by firearm type, intent, and payer in the U.S. *Inj Epidemiol*. 2017; 4(1):20.
39. Wexler L. "gun shy: how a lack of funds translates to inadequate research on gun violence in America". *Hopkins Bloomberg Public Health Fall*. 2017; https://magazine.jhsph.edu/2017/fall/features/cassandra-crifasi-hopkins-moderate-gun-owner-gun-policy-researcher/how-the-dickey-amendment-affects-gun-violence-research.html. Access 5 June 2018.
40. Greenberg J. Spending bill's gun research line: does it nullify dickey amendment? *Politifact*. 27 March 2018. http://www.politifact.com/truth-o-meter/article/2018/mar/27/spending-bills-gun-research-line-does-it-matter/. Accessed 6 June 2018.
41. Pinals DA, Anacker L. Mental illness and firearms: legal context and clinical approaches. *Psychiatr Clin North Am*. 2016;39(4):611–621.
42. Leiner M, De la Vega I, Johansson B. Deadly mass shootings, mental health, and policies and regulations: what we are obligated to do!. *Front Pediatr*. 2018;6:99.
43. Swartz MS, Bhattacharya S, Robertson AG, Swanson JW. Involuntary outpatient commitment and the elusive pursuit of violence prevention. *Can J Psychiatry*. 2017;62(2):102–108.
44. Studdert DM, Zhang Y, Rodden JA, Hyndman RJ, Wintemute GJ. Handgun acquisitions in California after two mass shootings. *Ann Intern Med*. 2017; 166(10):698–706.
45. Stroebe W, Leander NP, Kruglanski AW. The impact of the Orlando mass shooting on fear of victimization and gun-purchasing intentions: not what one might expect. *PLoS One*. 2017;12(8):e0182408.
46. Smith ER, Shapiro G, Sarani B. The profile of wounding in civilian public mass shooting fatalities. *J Trauma Acute Care Surg*. 2016;81(1):86–92.
47. Behrman P, Redding CA, Raja S, Newton T, Beharie N, Printz D. Society of Behavioral Medicine (SBM) position statement: restore CDC funding for firearms and gun violence prevention research. *Transl Behav Med*. 2018.
48. Wong S. "GOP chairman: congress should rethink CDC ban on gun violence research". *The Hill*. 15 February 2018 http://thehill.com/homenews/house/374149-gop-chairman-congress-should-rethink-cdc-ban-on-gun-violence-research. Accessed 5 June 2018.
49. Basu S, Meghani A, Siddiqi A. Evaluating the health impact of large-scale public policy changes: classical and novel approaches. *Annu Rev Public Health*. 2017;38:351–370.
50. Drange M. The Kentucky gun owner who developed his own count of gun violence in the US. *The Guardian*. 23 April 2016. https://www.theguardian.com/world/2016/apr/23/kentucky-gun-owner-gun-violence-archive-mark-bryant. Accessed 5 June 2018.
51. Murphy SL, Xu J, Kochanek KD, Curtin SA, Elizabeth Arias E. *National Vital Statistics Reports*. Volume 66, Number 6 November 27, 2017. Deaths: Final Data for 2015. Centers for Disease Control and Prevention.

DISCUSSION

Ernest E. "Gene" Moore, MD (Denver, Colorado): Thank you, Dr. Rotondo and Dr. Reilly. Can I please have the discussion video. [sounds of a gun shooting]. Well, that is the AR15 rifle. Literally, 30 potential lethal shots delivered within 10 seconds. Is this safe to have in our society?

I congratulate Dr. DiMaggio and his colleagues from NYU for their superb presentation on a very timely issue. The AAST has had a long-term interest in reducing gun violence in the United States, and has recently published our 14-point approach. Access to assault rifles is one of them. At a reductionist level, mass shootings are the net result of (1) a deranged person intending to kill random individuals in a populated area, and (2) the use of an assault rifle. Since we seem to be unable to identify

the active shooter preemptively, we are left with the alternative solution of eliminating the weapon.

The presentation today provides evidence that a federal assault weapon ban can reduce mass shootings. According to our recent national trauma surgeon surveys, three-fourths of us in the audience, including me, would like to believe the analysis; but I think we need to consider some of the potential limitations.

Many of these issues relate to the fact that research support for gun violence control in the United States remains frustratingly suppressed and fundamentally inadequate. The general lack of information, low quality of data, and need to merge data sets from diverse sources – medical, coroner, police, legal, and behavioral – compounded by scarce funding and public controversy, undermine research to inform policy and enlighten the public. The fact that you had to compare three open-access databases to be certain that the reported mass shootings occurred underscores this deficiency.

Furthermore, there is no definition of a mass shooting, although you employed perhaps the most acceptable at the moment – the FBI's definition. Could you explain for us the rationale for this definition?

You present an analysis of 44 events with four or more deaths, including the shooter, from 1981 to 2017 – a 36-year period; whereas, others suggest a much higher incidence, such as Klaveras, who reported 69 shootings of six or more over the past 27 years.

Identifying all known mass shootings per year during a study period would be useful to appreciate the overall trends, as your data somewhat understates the magnitude of mass shootings in the United States.

You employed the Gun Violence Archive to estimate homicides in 2017. Why did you not use this source for mass shootings? The Archive has reported an alarming 261 mass shootings – defined as six or more shot – thus far in 2018. Nonetheless, in the sample you studied, assault rifles accounted for greater than 85 percent of the fatalities, and this is the key issue.

You have evaluated the impact of the federal assault rifle ban by analyzing the rate of mass shootings per 10,000 firearm homicide deaths per year to adjust for confounders. This would assume that the factors influencing mass shootings are the same as those for homicides, which seems very unlikely. You have idicated that you analyzed mass-shooting fatalities per population per year; perhaps you could elaborate more about this analysis.

Another confounder as acknowledged in the presentation is the impact of individual state limitations on magazine capacity. The first state to enforce these limitations was New Jersey in 1990, and now at least eight states and Washington, D.C., have these restrictions in effect. How can we distinguish the effects of this policy? And could this be a potential bridge to ultimately reestablish a national assault rifle ban?

You have also calculated the case fatality of all weapons in mass shootings per 100 total shootings, finding a decrease since 2010. While you conjecture this may be due to indiscriminate injury from assault rifles or possibly attributed to better trauma care, I am uncertain how this is relevant to the issue of banning assault rifles. The Las Vegas shooting is a cogent example of how these data may be misleading.

Finally, there is the issue of so-called falsification that could be addressed by examining other causes of trauma mortality during this time period.

In sum, this study adds to overwhelming evidence that assault rifles are an essential component in the dramatic escalation of mass shootings in the United States. While the scientific data to support a federal ban on civilian assault rifles is imperfect due to inadequate research support, I submit collectively the existing information argues strongly for enactment of this measure, and compliment the authors for their timely contribution.

Sheldon H. Teperman, MD (Bronx, New York): Dr. DiMaggio, your home institution, Bellevue, plays a seminal role in the trauma center safety of our nation.

In fact, right now, your trauma medical director is not present with us, but he is at home on guard for the U.N. General Assembly. But in New York, we don't see long-gun injuries. New York has the Safe Act, and there is an assault weapons ban. So why is it so important to America's trauma center – Bellevue – that we see a national ban on assault rifles?

Charles E. Lucas, MD (Detroit, Michigan): Thank you for your nice presentation. How many of these incidents occurred in an inner-city environment, where most of the victims that we treat have received multiple wounds which were purposely inflicted in order to compete competitively for the distribution of heroin and other drugs? Also, how many of the assailants were African-American?

Martin A. Croce, MD (Memphis, Tennessee): Thank you. I want to commend the authors for an excellent study, and really, not so much to ask any questions but I rise to put out a plea to the membership that this issue is a public health problem.

This is not a right versus left problem, this is not a Second Amendment problem. This is a public health problem.

And to quote Wayne Meredith at one of the recent Board meetings, "Our primary goal is to reduce the number of bullet holes in people." So I implore the Membership to correct this dearth of research that is going on about gun violence in order to promote a public health approach, so that we can reduce the number of bullet holes in people.

Deborah A. Kuhls, MD (Las Vegas, Nevada): And to carry on that thought, I would urge the authors to incorporate the public health data from the CDC when it is available, because part of the methodological issues for this paper is that one data set was used for a certain period of time.

But for the last year, the CDC data was not used because it was not available, so I would urge you to not only do that analysis, but I would also urge the Journal of Trauma to consider an update to that article when that is available. Thank you.

Charles DiMaggio, MPH, PhD (New York, New York): Thank you very much for all these comments and questions.

Dr. Moore, so with regard to your observation about the reductionist approach to looking at this particular issue, that puts me in the mind very much of the traditional epidemiologic triad of agent, host, and environment, and if you break one link in that connection, you can break the transmission. In this case, we could call assault weapons one link, whether it's agent or host, we can decide.

With regards to the rationale for the definition, I think it's reflective of the lack of research in this area.

A case definition is an essential and critical first step in any epidemiologic investigation, and you can see that we are barely there. I think the FBI definition makes sense, I think it's the oldest one, I think it's informed by expert consensus.

And I think all the other definitions are based in some form on that, which is why we chose it. And I would urge that if we are going to be doing this research going forward, probably it would be best if we all had the consensus that that be the definition.

Why did we not use the Gun Violence Archive to estimate some of these results, and why are our numbers so much smaller than some of the other numbers? I have to agree, our numbers are very much an under-count.

We restricted our analysis to these three databases. And so the limiting factor was the one database. And I can tell you it was the LA Times – they had the fewest number. And if it wasn't in the LA Times, then the other databases didn't contribute to this data set.

We felt that the important aspect of this particular study was to demonstrate the relative effects, merits or associations with the assault weapon ban as opposed to documenting the absolute numbers.

So the Gun Archive, for example, defines mass shootings as four or more deaths or injuries. That really raises the number of deaths that can be included. We didn't include it, but I think going forward we absolutely should.

With regard to the analysis using population denominators, we agree, actually, that gun homicides are an imperfect denominator. We also felt that population was an imperfect denominator. And again, as we keep on circling around, it has to do with the data in this case.

We did feel that gun homicides captured something about gun availability and criminality in the United States, although homicides themselves differ very much from these mass shooting fatalities.

We do note that our population-based results essentially mirrored the gun homicide results, indicating that, at least for the relative effects and benefits of the assault weapons ban, the results are robust and invariant to the choice of denominator in this case.

Can we distinguish local effects, and could this possibly be a bridge to reestablishing an assault rifle ban? The short answer is yes and yes. We can distinguish local effects.

We took a very broad approach on this particular study as a first pass on the data. But, there are data sources (and even within the data sources we used) where you can tease out local, municipal and state policies.

Also, we can link our data to other sources that have those variables. There are statistical methods available that will not only account for those variables, but also allow us to measure or estimate in some way the contribution of local or regional variation in these policies to the overall effectiveness.

The issue of the case fatality rate is very interesting and challenging. I want to note that there was a paper in JAMA on September 11th – just a couple of weeks ago – looking at mass shooter fatalities, that came essentially to the same conclusion – that there has been this recent decrease.

In our paper, in this write-up, we look at three potential explanations, and one of them is, first of all, it's just a matter of denominator. These are indiscriminate weapons.

You have someone shooting at a large group of people, and there are going to be more injuries and more casualties, and it just inflates the denominator in this case.

The second thing is, the obverse of that, is single-fire weapons, guns, are very personal weapons. They're usually characterized by someone who knows who they want to kill. And finally, we feel that perhaps there may be some improvement by the folks in this room in treating these.

I'm going to close at this point, given the time constraints.

EXHIBIT 70

Letter to the editor re: DiMaggio, C. Et al. "Changes in U.S. mass shooting deaths associated with the 1994–2004 federal assault weapons ban: Analysis of open-source data. *J Trauma Acute Care*. 2019;86(1):11–19."

To the Editor:

Following a series of shooting rampages in the late 1980s and early 1990s, Congress passed the federal Assault Weapons Ban (AWB). Enacted on September 13, 1994, the law remained in effect for a 10-year period, before it was allowed to sunset on September 13, 2004. During that decade, it was illegal to purchase or possess assault weapons (as defined in Table 1) as well as large-capacity magazines (capable of holding more than 10 rounds of ammunition).

The ban, however, contained several prominent loopholes, including exempting numerous firearms that might otherwise be considered assault weapons if they were specifically identified in the legislation as well as exempting firearms and magazines legally in circulation prior to the enactment date of the law.

As Congress again debates the merits of a nationwide AWB, the publication of a study by DiMaggio et al. in *The Journal of Trauma and Acute Care Surgery* assessing the impact of the 1994 AWB on mass shootings is a timely addition to the literature.[1] Specific to the use of assault weapons in mass shootings, DiMaggio et al. presented three key findings:

1. Of the 44 mass shootings identified by the study between 1981 and 2017, 34 (77%) involved assault weapons, and these 34 incidents accounted for 430 (86%) of the 501 fatalities incurred in the 44 total mass shootings.
2. During the 37-year period of 1981 to 2017, there were 24 years in which a mass shooting occurred, and assault weapons accounted for *all* mass-shooting fatalities in 15 (63%) of those 24 years.
3. A statistical analysis of the 34 mass shootings involving assault weapons indicated that, during the decade that the AWB was in effect, seven preventable deaths were attributable to assault weapons alone.

TABLE 1. Definition of an Assault Weapon Pursuant to 1994 Federal AWB

Firearm	Required Features	Additional Requirements
Handgun	• Semiautomatic • Ability to accept detachable magazine	At Least Two of the Following Features: • An ammunition magazine that attaches to the pistol outside of the pistol grip • A threaded barrel capable of accepting a barrel extender, flash suppressor, forward handgrip, or silencer • A shroud that is attached to, or partially or completely encircles, the barrel and that permits the shooter to hold the firearm with the non-trigger hand without being burned • A manufactured weight of 50 ounces or more when the pistol is unloaded • A semiautomatic version of an automatic firearm
Rifle	• Semiautomatic • Ability to accept detachable magazine	At Least Two of the Following Features: • A folding or telescoping stock • A pistol grip that protrudes conspicuously beneath the action of the weapon • A bayonet mount • A flash suppressor or threaded barrel designed to accommodate a flash suppressor • A grenade launcher
Shotgun	• Semiautomatic	At Least Two of the Following Features: • A folding or telescoping stock • A pistol grip that protrudes conspicuously beneath the action of the weapon • A fixed magazine capacity in excess of 5 rounds • An ability to accept a detachable magazine

Source: 18 U.S.C. §921(a)(30) [1994]; repealed.

There is only one conclusion to draw after reading the above findings: with regard to mass shootings, assault weapons are more lethal than other firearms, but tough restrictions on such military-style weapons, like the 1994 AWB, can save lives.

Unfortunately, the first two findings are incorrect, calling into question the third finding and any broader conclusion that can be drawn from the study regarding the impact of the AWB.

After reviewing the study's data set, I believe that the authors misidentified the involvement of assault weapons in roughly half of the incidents (Table 2) (the study examined 44 incidents, but the number should actually be 43, not 44, given that the authors erroneously coded the 2014 Isla Vista rampage as a mass shooting. While six people died in that attack, only three were shot to death. The other three were stabbed to death. As a result, this incident fails to meet the authors' criterion that a mass shooting results in a minimum of four people being shot to death).

When the erroneous cases are recalibrated, the number of incidents involving assault weapons drops 62% from 34 to 13, and the number of fatalities resulting from such shootings drops 46% from 430 to 232 (Table 2). This brings the percentage of mass shootings involving assault weapons in the DiMaggio et al. data set from 77% to 30%—which is consistent with other studies that have found that assault weapons are used in 25% to 36% of active shootings and mass shootings.[2–5] Furthermore, the percentage of mass shooting fatalities resulting from incidents involving assault weapons decreases from 86% to 47%—which is consistent with other studies that have found that assault weapons account for 29% to 44% of active shooting and mass shooting deaths.[3,5–7]

If my corrections to the data set are accurate, then assault weapons accounted for *all* mass-shooting fatalities in only 3—not 15—of the 23 years in which there was a mass shooting (Table 2). With such a large number of misclassifications, the study's overarching conclusion about the effect of the AWB is called into question.

Sincerely,

Louis Klarevas, Ph.D. / University of Massachusetts, Boston / louis.klarevas@umb.edu

TABLE 2. Recalibration of Original DiMaggio et al

	Year	City	State	Reported Assault Weapons Involvement in Mass Shooting Incident	Actual Assault Weapons Involvement in Mass Shooting Incident	Reported Deaths in Mass Shooting Incident	Actual Deaths in Mass Shooting Incident	Reported Deaths in Assault Weapons Incident	Actual Deaths in Assault Weapons Incident
1	1984	San Ysidro	CA	Y	Y	21	21	21	21
2	1986	Edmond	OK	Y	N	14	14	14	0
3	1989	Stockton	CA	Y	Y	5	5	5	5
4	1990	Jacksonville	FL	N	N	10	9	0	0
5	1991	Killeen	TX	Y	N	22	23	22	0
6	1991	Iowa City	IA	N	N	4	5	0	0
7	1992	Olivehurst	CA	N	N	4	4	0	0
8	1993	San Francisco	CA	N	Y	8	8	0	8
9	1993	Garden City	NY	Y	N	6	6	6	0
10	1998	Jonesboro	AR	Y	N	5	5	5	0
11	1999	Columbine	CO	Y	Y	13	13	13	13
12	1999	Atlanta	GA	Y	N	9	9	9	0
13	1999	Fort Worth	TX	Y	N	7	7	7	0
14	1999	Honolulu	HI	Y	N	7	7	7	0
15	2000	Wakefield	MA	Y	Y	7	7	7	7
16	2003	Meridian	MS	Y	N	5	6	5	0
17	2005	Red Lake	MN	Y	N	9	9	9	0
18	2006	Goleta	CA	Y	N	6	7	6	0
19	2006	Nickel Mines	PA	Y	N	5	5	5	0
20	2007	Salt Lake City	UT	N	N	5	5	0	0
21	2007	Blacksburg	VA	Y	N	32	32	32	0
22	2007	Omaha	NE	Y	Y	8	8	8	8
23	2008	DeKalb	IL	Y	N	5	5	5	0
24	2009	Binghamton	NY	Y	N	13	13	13	0
25	2009	Fort Hood	TX	Y	N	13	13	13	0
26	2010	Manchester	CT	Y	N	8	8	8	0
27	2011	Tucson	AZ	Y	N	6	6	6	0
28	2011	Seal Beach	CA	Y	N	8	8	8	0
29	2012	Oakland	CA	Y	N	7	7	7	0
30	2012	Aurora	CO	Y	Y	12	12	12	12
31	2012	Oak Creek	WI	Y	N	6	6	6	0
32	2012	Minneapolis	MN	Y	N	6	6	6	0
33	2012	Newtown	CT	Y	Y	27	27	27	27
34	2013	Santa Monica	CA	Y	Y	5	5	5	5
35	2013	Washington	DC	N	N	12	12	0	0
36	2015	Charleston	SC	N	N	9	9	0	0
37	2015	Chattanooga	TN	Y	Y	5	5	5	5
38	2015	Roseburg	OR	N	N	9	9	0	0
39	2015	San Bernardino	CA	Y	Y	14	14	14	14
40	2016	Orlando	FL	Y	Y	49	49	49	49
41	2016	Burlington	WA	N	N	5	5	0	0
42	2017	Fort Lauderdale	FL	N	N	5	5	0	0
43	2017	Las Vegas	NV	Y	Y	59	58	59	58
		Total deaths				495	497	424	232
		Total Y cases		33	13				
		Total N cases		10	30				

Note: Original DiMaggio et al. data set available at http://www.injuryepi.org/styled-2 (Accessed 6 January 2019). The original data set contained an additional incident—the 2014 Isla Vista rampage—which was erroneously coded as a mass shooting. Including that incident in the original reported tallies increases the total incidents to 44, the total deaths to 501, and the total deaths attributed assault weapons incidents to 430 (although this case was originally miscoded as involving assault weapons, which it did not involve.)

Data set to correct errors.

DISCLOSURE

The author declares no conflict of interest.

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REFERENCES

1. DiMaggio C, Avraham J, Berry C, et al. Changes in US mass shooting deaths associated with the 1994-2004 federal assault weapons ban: analysis of open-source data. *J Trauma Acute Care Surg*. 2019;86(1):11–19.
2. Blau BM, Gorry DH, Wade C. Guns, laws and public shootings in the United States. *Appl Econ*. 2016;48(49):4732–4746.
3. Klarevas L. *Rampage Nation: Securing America from Mass Shootings*. Amherst, NY: Prometheus; 2016.
4. Koper CS, Johnson WD, Nicholas JL, Ayers A, Mullins N. Criminal use of assault weapons and high-capacity semiautomatic firearms: an updated examination of local and national sources. *J Urban Health*. 2018;95(3):313–321.
5. de Jager E, Goralnick E, McCarty JC, et al. Lethality of civilian active shooter incidents with and without semiautomatic rifles in the United States. *JAMA*. 2018;320(10): 1034–1035.
6. Gius M. The impact of state and federal assault weapons bans on public mass shootings. *Appl Econ Lett*. 2015;22(4):281–284.
7. Brown JD, Pharm D, Goodin AJ. Mass casualty shooting venues, types of firearms, and age of perpetrators in the United States, 1982-2018. *Am J Public Health*. 2018;108(10): 1385–1387.